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Carpentry for the Building Trades

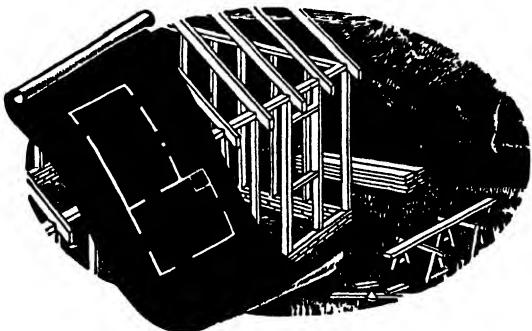
C A R P E N T R Y

for the Building Trades

by E. A. LAIR

Instructor in Building Trades

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McGraw-Hill Book Company, Inc.

NEW YORK AND LONDON

CARPENTRY FOR THE BUILDING TRADES

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SECOND PRINTING

b94
L33C
31565
C/66 6/81
C196
C196

*The quality of the materials used in the manufacture
of this book is governed by continued postwar shortages.*

P R E F A C E

The aim of this book is to provide in text form the essentials of practical carpentry for the building trades; to bring into organized form the fundamental objectives of the construction of the small and medium-sized frame house; and to provide a definite course for high school, technical school, vocational school, apprenticeship, and veterans' apprenticeship classes in carpentry.

The author has departed completely from the old method of building models, so often used, because a boy who is to earn his living in this trade will need to know it as it is actually performed today. The author has kept in mind the knowledge and the operations in carpentry that seem most essential for the student desiring to secure employment as an advanced apprentice.

The framework of a building made from materials of standard dimensions can be constructed in the school shop. A building of this type provides opportunity for training in such jobs as placing sills and joists; putting up studs and plates; cutting and installing rafters, siding, and sheathing; shingling; setting window and door frames—in fact, all the jobs that are to be found in frame-house construction.

The best type of training, however, is to have an actual house under construction, for, although various kinds of jobs and projects may offer many ways of teaching fundamentals, actual work on construction for customers will develop the skill and provide the essentials necessary to the training of the student and apprentice in carpentry for the building trades.

The author's intention was to make the material flexible enough to allow teachers to broaden the scope of the course in some cases

and lessen it in others, as the situation in various localities and available equipment demand. Probably the most satisfactory accomplishment of the desired objectives can be attained by those students who have completed at least two semesters of woodwork.

E. A. LAIR

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F R A M I N G

Many of the following operations cannot be taught except as they are actually worked out and developed on a building project. Actual house building will fill this requirement. An effort should be made not only to gain a knowledge of construction but to develop skill in the use of carpentry tools. After these have been attained, strive for speed, accuracy, and neatness.

Tools. There are many makes of carpentry tools on the market. Some of them are very good; some, very poor. None of them is efficient unless kept clean and in good working order. Plane blades should be kept sharp. Saws should be well shaped, and hammer handles should be kept tight. The proper care and condition of his tools are the first essentials of a skilled and efficient mechanic.

The tool chest of the building trades student should consist of the following:

- 1 ripsaw
- 1 crosscut saw
- 1 jack plane
- 1 ratchet brace
- 1 set auger bits, Nos. 4 to 16
- 1 countersink

Carpentry for the Building Trades

- 1 marking gauge
- 1 sliding T bevel, 8 in.
- 1 miter square, 8 in.
- 1 steel square, 24 in. (with rafter table)
- 2 screw drivers, 6 in. and 12 in.
- 1 screw-driver bit
- 1 pliers (wire cutting)
- 1 mallet
- 4 wood chisels, $\frac{1}{4}$ in., $\frac{1}{2}$ in., 1 in., $1\frac{1}{2}$ in.
- 1 saw vise
- 2 8-in. slim taper files
- 1 10-in. flat mill file
- 1 12-in. half-round wood file
- 1 pair of 8-in. dividers
- 1 6-ft. steel or aluminum rule
- 1 28-in. aluminum level
- 1 hammer—straight claws—16 oz.
- 1 oilstone
- 2 nail sets, $\frac{1}{16}$ in. and $\frac{1}{8}$ in.
- 1 coping saw
- 1 compass saw
- 1 Yankee drill with bits
- 1 backsaw
- 1 chalk line and chalk
- 1 tin snips
- 1 hatchet

Joints. It is necessary that the building trades student be able not only to use and care for his tools, but also to make the various joints and construction details, commonly found in the building of a house, before being assigned to work on any building of importance.

Braced framing of houses has been almost completely replaced today by balloon framing and western framing. However, there are still a number of joints in common use, as shown in Fig. 1.

TYPES OF FRAMING

There are three types of framing for small-house construction, commonly known as (1) balloon framing, (2) western framing (platform), and (3) braced framing. Regardless of the type of

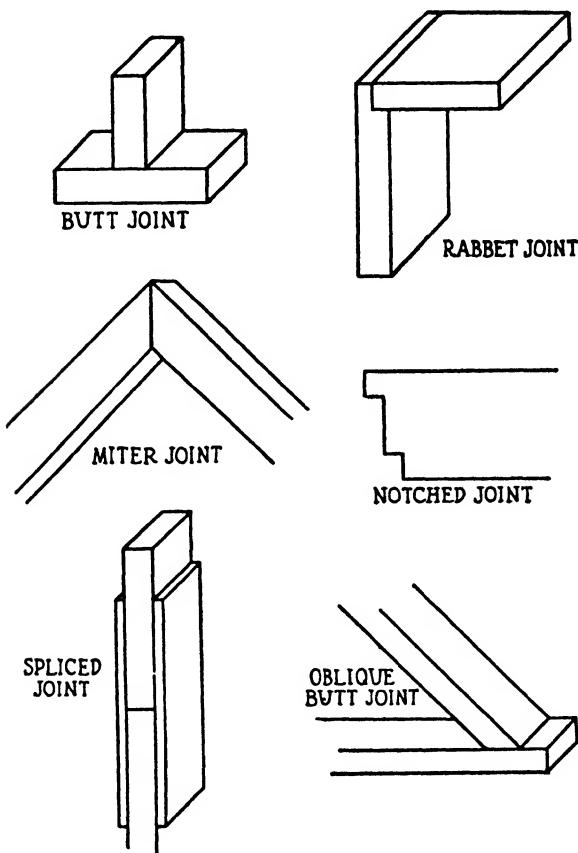


Fig. 1.—Joints in common use.

framing, each must be strong and rigid and sturdy. Long durability and resistance to wind, tornado, earthquakes, settling, and twisting must all depend upon a strong, well-built frame.

General opinion may vary as to which is the best type of con-

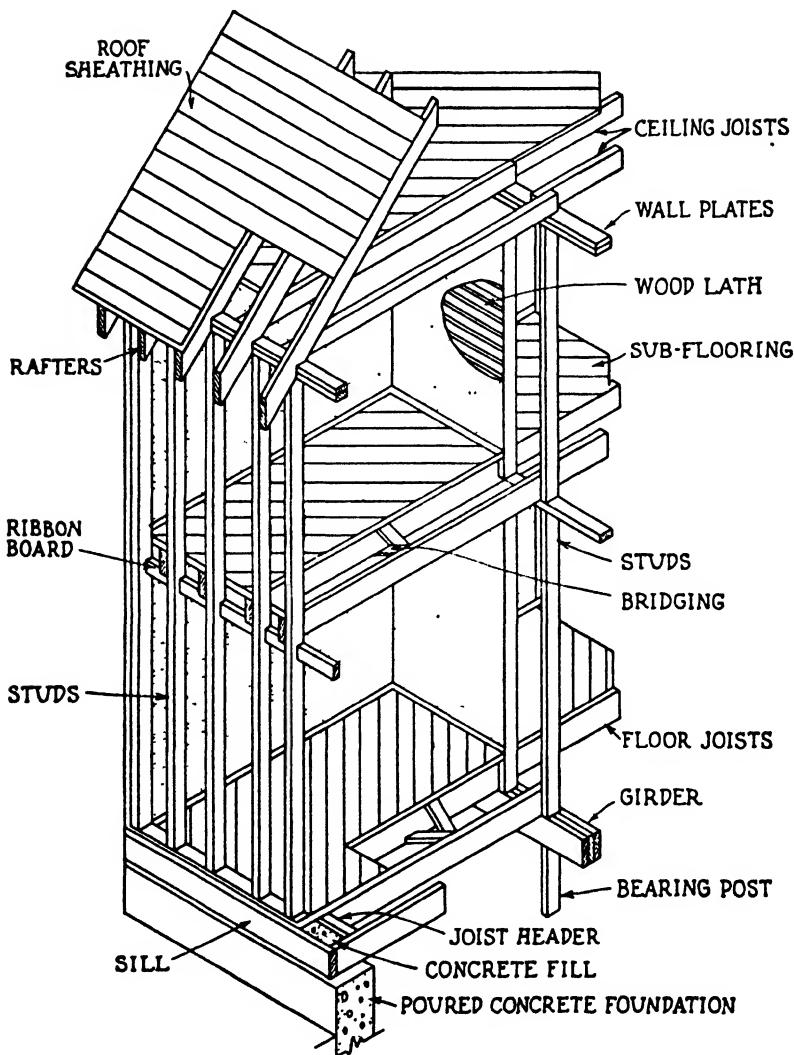


Fig. 2.—Balloon framing.

struction, but part of the question can be settled by certain factors, such as the materials obtainable, the locality, and the climate. For example, a house built in that part of the country where strong winds prevail would probably call for braced framing.

Balloon framing. Balloon framing is a term given to that type of construction in which the framework of the building is spiked together with butt joints. It depends largely for its strength upon the exterior covering or boxing and upon the manner in which it is applied. Another characteristic is the use of studs extending in one piece from the foundation to the roof. The joist ends are nailed to the studs and are supported on a ribbon or ledger board which has been let into the studs (Fig. 2).

Western framing. Western framing, sometimes called "platform" framing, is a term given to that type of construction in which the framework of the building is built up in floors, or one story at a time. Each floor is independently framed. The second story and the third are supported by studs only one story high. This type is usually easier for the apprentice because short pieces are generally used. Another merit lies in the fact that, if any shrinkage occurs, it is likely to be uniform throughout and so is unnoticeable (Fig. 3).

Braced framing. Braced framing is a term given to the type of construction that is characterized by heavy timbers at the corners, often with intermediate posts, all of which extend continuously from a heavy foundation sill to an equally heavy plate at the roof line. Most of the joints are mortised, and some are fastened with pins. Knee braces are used at the corners and are notched in at the plates and corner posts.

This is perhaps the oldest type of framing, having been brought to this country from England. However, it has been gradually modified, and timbers have been reduced in size. Originally the studs were only fillers, to which the lath and plaster were nailed. They supported nothing else. At present, however, they are an integral part of the structure and act to support the floors, roofs, etc., similar to other types of framing (Fig. 4).

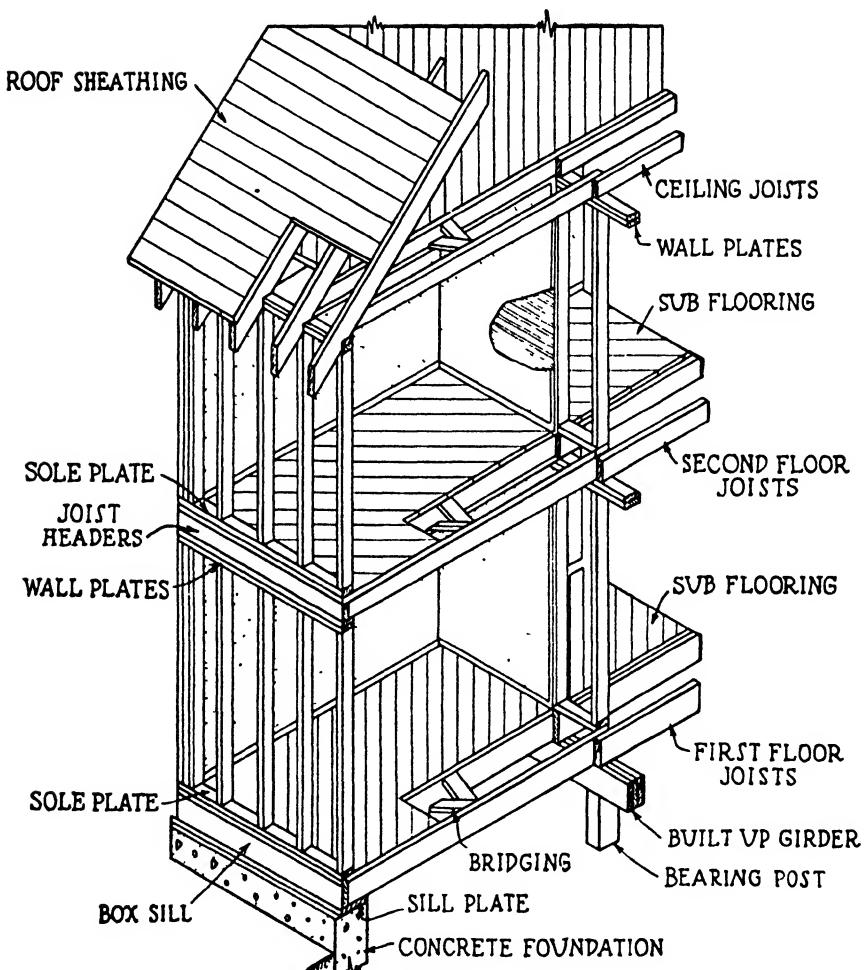


Fig. 3.—Western framing.

TYPE JOBS

The type jobs listed below have been selected because of their constant recurrence in frame-house construction. It is our purpose

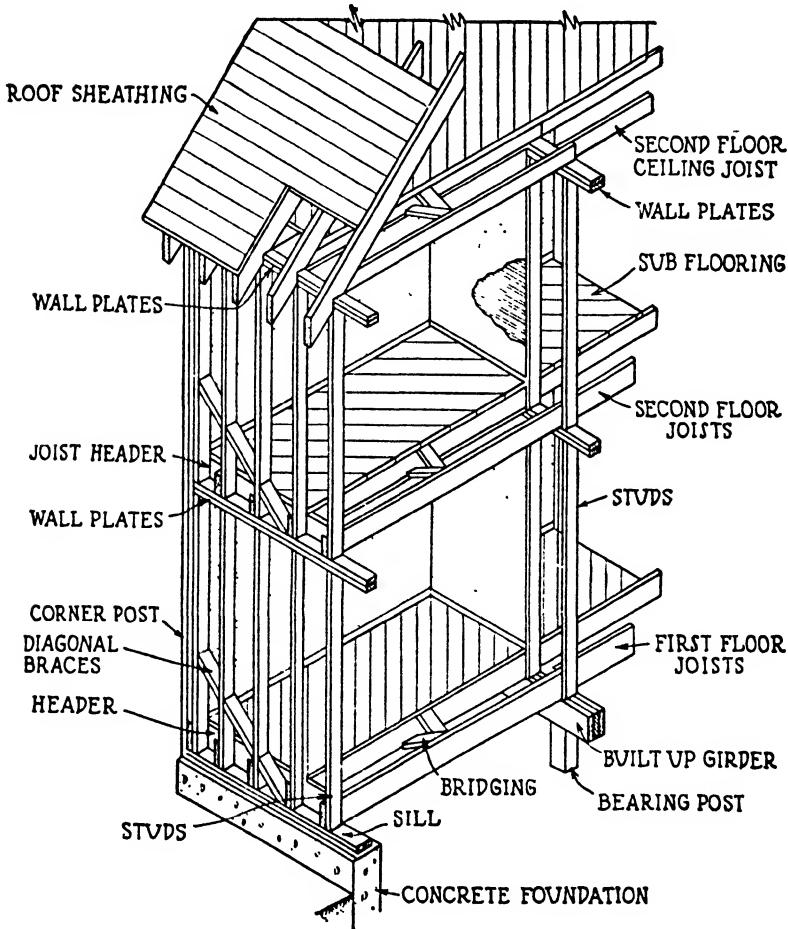


Fig. 4.—Braced framing.

here to give the student certain technical information that can be coupled with his practical experience on the job under the direction of the trade teacher. An honest attempt should be made to execute

the practical processes without violating technical factors. The following type jobs are listed about in the order in which they would be brought into construction on a building.

FOOTINGS

Definition. Regardless of the type of framing employed or how rigidly the frame is built, if an inadequate foundation is provided, the frame will probably settle unevenly. This uneven settlement will result in the cracking of plaster, tile, and floors, and in ill-fitting doors and sticking windows. Wall footings and post footings are sometimes figured undersize and in some cases left entirely out of the construction.

Purpose. Pier footings, of course, carry the pier post, which, in turn, carries the girders. These footings, underposts, and girders of the average frame house carry a much greater load per square foot of bearing surface than do the foundation walls. For example, in Fig. 5 we have a house 22 ft. 0 in. square with one girder and one pier post set on one footing. The footing is 2 ft. square.

Size. All the weight over the shaded area will fall on this footing. If the building weighs 60 tons, 15 tons will be carried by this center footing, or $3\frac{3}{4}$ tons per sq. ft. This may be more than the soil will carry without settling. On the other hand, the wall footings, because of a greater area of bearing surface, will support about $\frac{1}{2}$ ton per sq. ft.

Spacing. Therefore, the load on each pier footing should be carefully figured and the footing made large enough to carry loads per square foot not to exceed the following:

Hard pan, not less than 1 sq. ft. for every 4 tons

Sand or clay, not less than 1 sq. ft. for every 2 tons

Loam, not less than 1 sq. ft. for every ton

The depth of a pier footing is usually determined by taking one-half the length of one side. For example, a footing 2 ft. square would have a depth of 1 ft.

Construction. In all cases, excavations for footings should be made well under the frost line. Because of the possibility of settling no permanent building should be erected over any fresh fill, and in

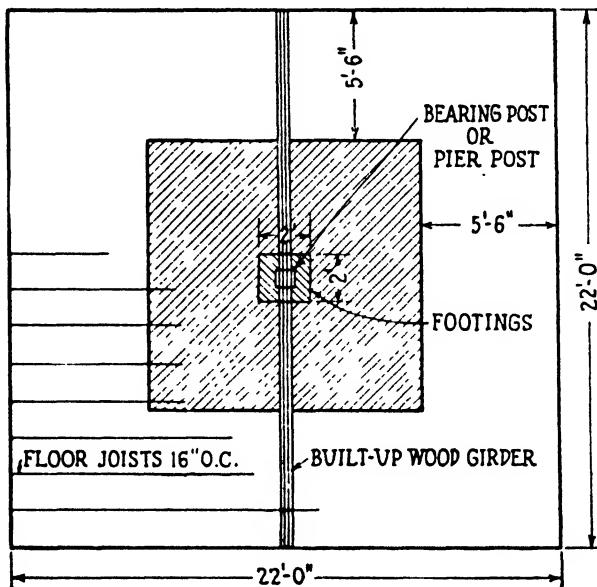


Fig. 5.—The post in the center will support one-fourth the total weight of the building. Sometimes this footing may be required to support ten times as much "per square foot" as the wall footings.

extreme cases, if such is necessary, an engineer or architect should be consulted before any work is started.

BEARING POSTS

Definition. Bearing posts (Fig. 6) in frame-house construction are vertical members of wood usually set on a footing of poured concrete in the basement.

Purpose. Their purpose is to support the girders.

Size. The size is determined by the amount of weight to be placed on them and is usually figured by the architect or engineer. No wood post smaller than 6 by 6 in. should ever be used in a frame

house. Smaller posts may be actually strong enough to carry the load, but they do not appear so and may cause the owner to doubt their strength.

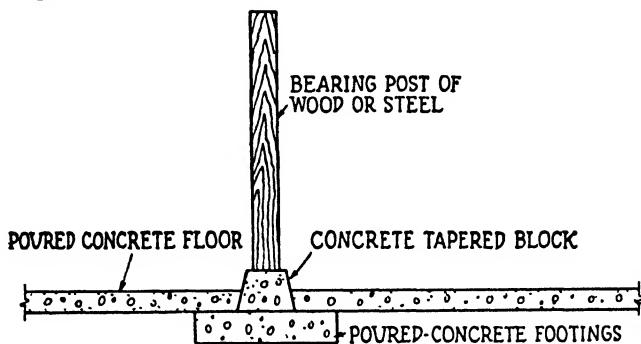


Fig. 6.—The bearing post should rest on a concrete tapered block which in turn rests on a poured-concrete footing.

Spacing. Spans between posts should seldom exceed 8 ft. This is to avoid concentration of weight on one footing. Longer spans require larger girders and reduce headroom in the basement.

Construction. The exact length of a post is usually determined by stretching a chalk line from the top of one wall foundation to

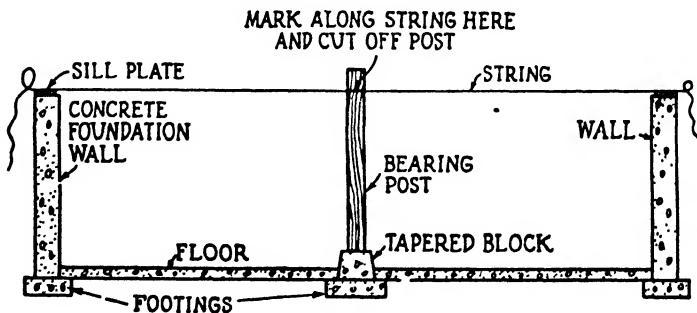


Fig. 7.—To obtain the exact length of a bearing post.

the top of the other (Fig. 7). The post should be anchored at the bottom to the footing by a $\frac{3}{4}$ -in. bolt or reinforcing rod set in the concrete from 4 to 6 in.

FOUNDATION SILLS

Definition. The foundation sill is a plank laid directly on the foundation wall.

Purpose. It is the actual bearing surface for the outside walls of the building. The floor joists of the building rest upon it.

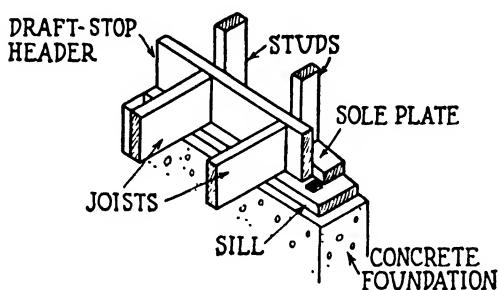


Fig. 8.

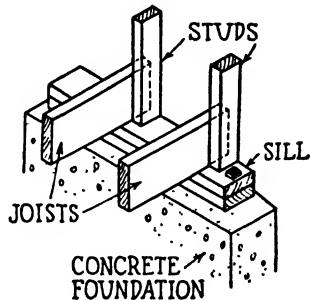


Fig. 9.

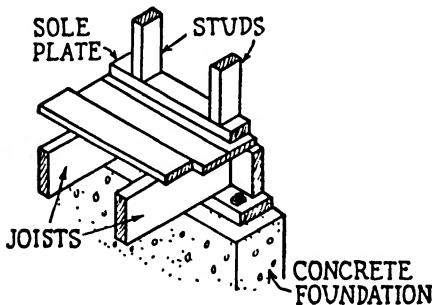


Fig. 10.

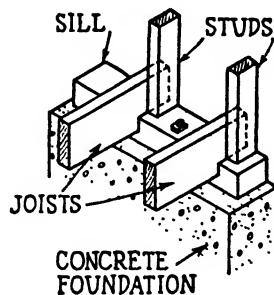


Fig. 11.

Fig. 8.—T-sill construction.

Fig. 9.—Balloon-frame construction.

Fig. 10.—Box-sill construction.

Fig. 11.—Braced-frame sill construction.

Size. Sizes vary, but generally a sill will be a 2- by 6-in. or a 2- by 8-in. plank. In braced framing it is usually 4 by 6 in. or 4 by 8 in. This allows more space for nailing on the wall sheathing and

makes for a stronger frame. The length of the sills is determined by the size of the building, as they are laid around the entire top of the foundation. All sill timber should be straight to provide satisfactory bearing for the joists and studs.

Anchoring. It is important that the sills be anchored to the building foundation. This is done by setting, at intervals of from 6 to 8 ft., $\frac{3}{4}$ -in. bolts that extend at least 12 to 18 in. into the foundation wall. They should project through the sill far enough to receive a washer and nut. Figure 8 shows a T sill; Fig. 9 shows a balloon sill. Figure 10 shows a box sill for western framing; Fig. 11, a sill for braced framing.

HOW TO INSTALL GIRDERS

Definition. In frame-house construction a girder is a large beam placed at the first-floor line even with the top of the foundation line. It takes the place of an interior foundation wall. Its ends rest on the foundation walls, and its middle is supported by bearing posts.

Purpose. The purpose of a girder is to support the inner ends of the floor joists.

Size. A girder should be strong enough for its load. However, any size larger than that is wasted material (see Table 1).

Spacing. In planning the number and location of girders, consideration must be given to the permissible length of joists, the room arrangement, and the location of bearing posts. It is always desirable to locate the girders directly under, or very close to, bearing partitions, in order to avoid the necessity of larger joists. Room arrangement will generally determine the location of girders. Girders are quite often built up from other pieces spiked together. For example, a built-up wood girder, size 6 by 8 in., would probably be three 2- by 8-in. pieces spiked together with all joints coming directly over the bearing posts and staggered (Figs. 12 and 13).

TABLE 1.—MAXIMUM SPANS FOR WOOD GIRDERS

Size of girders	Maximum clear spans	
	1-story house	1½- and 2-story house
4" x 6"	5' 0"	4' 0"
6" x 6"	6' 0"	5' 2"
4" x 8"	6' 4"	5' 6"
4" x 10"	8' 0"	7' 0"
6" x 8"	8' 0"	7' 0"
6" x 10"	9' 0"	8' 0"

NOTE. The above spans are based on a minimum fiber stress of 1,200 lb. When the allowable fiber stress of the species of wood used is other than 1,200 lb., spans should not exceed those determined by established engineering practice. If the total of the spans of joists framing into the girder on both sides exceeds 24 ft. 2 in. or if loads are concentrated, the size and span of the girder should be determined by established engineering practice.

JOISTS

Definition. Joists may be either floor or ceiling joists. Floor joists are the members that actually carry the floors. They rest upon the foundation sills or girders, or both. Ceiling joists usually rest upon wall plates at each end.

Purpose. To the floor joists is nailed the subfloor. Between them is nailed the bridging. To the ceiling joists is nailed the lath for plastering, or any other ceiling material used.

Size. As in the case of girders, the sizes of joists are determined by several factors. Some of these are the span of joists, amount of load, dead and live weight per square foot, and joist spacing. Engineering practice has established tables for this purpose which can be safely used (Table 2).

Spacing. Joists are generally spaced 16 in. apart on center. Start at one end of the building and work toward the other. Spacing is determined by the length of the lath, which is commonly 4 ft. For

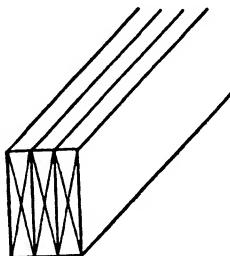


Fig. 12.—Built-up girders are usually made by spiking together three pieces as shown. Pieces should be well nailed, and all joints made over the bearing posts.

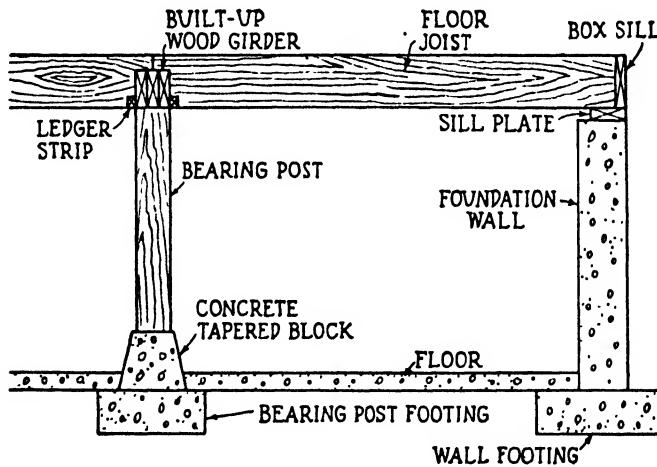


Fig. 13.—Girder and floor-joist arrangement.

balloon framing the joists should be placed against the stud and well spiked to it. In braced framing, the method of nailing will be the same. However, in platform framing the joists should be spaced and securely toenailed to the plate with 10d nails common. They should also be nailed to the box header from the outside into the ends of the joists. Figures 14 and 15 show good types of girder construction.

TABLE 2.—MAXIMUM SPANS FOR FLOOR JOISTS

Assumed live load, 40 lb. per sq. ft.; dead load, 10 lb. per sq. ft.; minimum fiber stress, 1,200 lb.

Douglas fir, southern yellow pine, western pine

<i>Lumber size</i>	<i>Spacing center to center</i>	<i>Maximum clear span</i>
2" x 6"	16"	9' 1"
2" x 6"	12"	10' 0"
2" x 8"	16"	12' 1"
2" x 8"	12"	13' 3"
3" x 8"	16"	14' 0"
3" x 8"	12"	15' 4"
2" x 10"	16"	15' 3"
2" x 10"	12"	16' 8"
3" x 10"	16"	17' 8"
3" x 10"	12"	19' 3"
2" x 12"	16"	18' 5"
2" x 12"	12"	20' 1"

Figure 16 illustrates good construction, but headroom in the basement is reduced.

JOIST HEADERS

Definition. Joist headers are auxiliary joists usually run at right angles to the regular joists.

Purpose. They are used wherever it is necessary to cut regular joists in order to provide an opening, such as a stair well, hearth

well, or chimney. They are spiked to the ends of the joists that have been cut (Fig. 17).

Size. Although the size of joist headers is usually the same as that of the joists, it is sometimes necessary to double the header in order to carry the load.

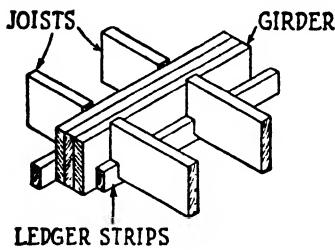


Fig. 14.

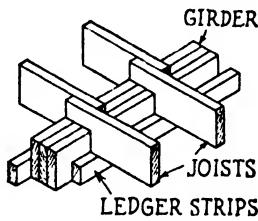


Fig. 15.

Fig. 14.—Girder construction for balloon framing. The joists are notched out and rest on a ledger strip. This method does not reduce the headroom in the basement.

Fig. 15.—This is a girder construction for braced and western framing.

Spacing. Spacing is determined by the size of opening made in the floor or ceiling. The length of the header is the distance between its two supports. The header should fit tightly between the trimmers and should be well spiked through the trimmer into the ends of the header.

TRIMMERS

Definition. Any regular or extra joist supporting a header is called a "trimmer" (Fig. 17).

Purpose. They are used to support the headers.

Size. Their size is the same as that of the joists.

Construction. See joists for the construction of trimmers.

CEILING JOISTS

Definition. Ceiling joists carry no flooring but provide the only means for carrying the plaster or ceiling of the room. They rest on the top plates.

Purpose. Their purpose is to carry the ceiling and tie the building together (Fig. 18).

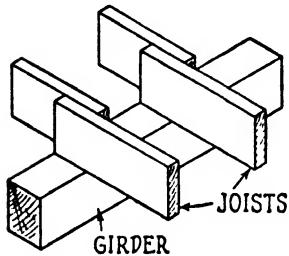


Fig. 16.

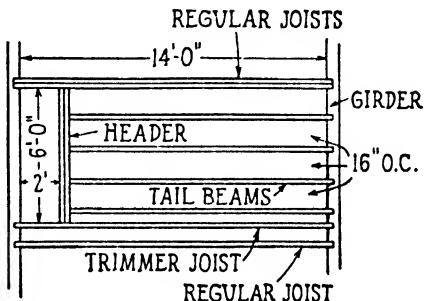


Fig. 17.

Fig. 16.—Joists lapped on top of the girder. A very good method but it reduces headroom. When headroom is reduced, it requires a higher foundation wall.

This, of course, adds to the cost of the house.

Fig. 17.—Joist headers are used where it is necessary to cut regular joists to provide an opening.

Size. Ceiling joist sizes are also determined by the amount of span and load (see Table 3). As a rule, they are required to be strong enough to carry only their own weight and that of the plaster or ceiling material below them. If the attic space is to be used, the ceiling joists should be figured as floor and ceiling joists.

Spacing. Ceiling joists are generally spaced 16 in. on center because of the standard lengths of 4 ft. for laths.

Construction. Whenever possible, ceiling joists should be placed so as to tie the building together at the top plate. This can be done by nailing securely the joist to the plate, and the joist to the lower

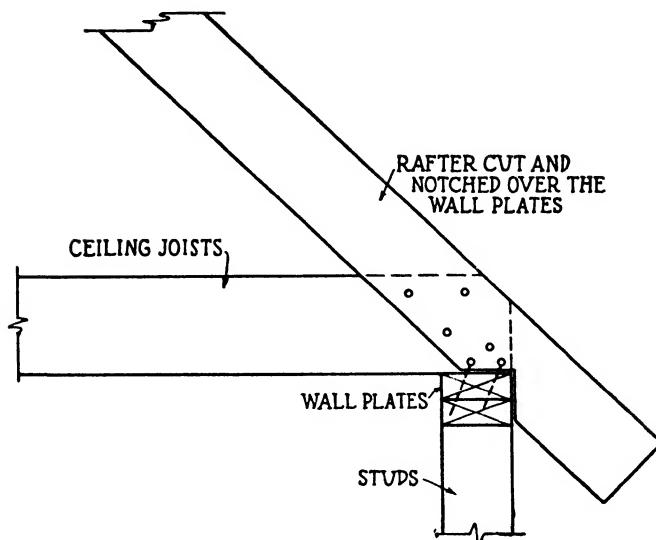


Fig. 18.—Rafters should be nailed to the wall plates and to the ceiling joists.

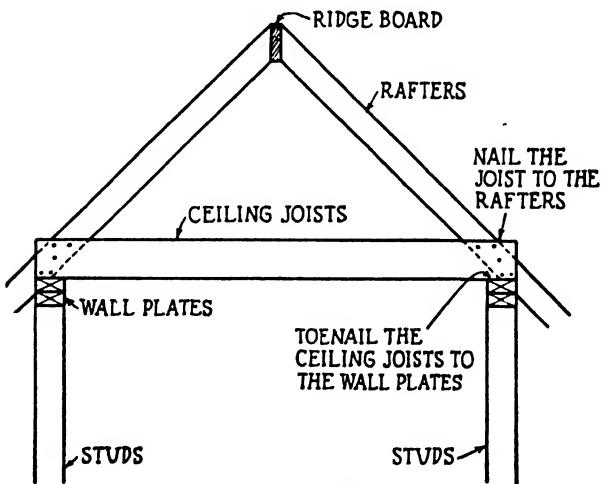


Fig. 19.—Whenever possible, ceiling joists should be placed so as to tie the building together at the top plate.

end of the rafters (see Fig. 19). This will counteract the outward thrust of the rafters.

TABLE 3.—MAXIMUM SPANS FOR CEILING JOISTS

Live load, none; dead load, 10 lb. per sq. ft.; minimum fiber stress, 1,200 lb.

Douglas fir, yellow pine, western larch

Lumber size	Spacing center to center	Maximum clear span
2" x 4"	20"	9' 6"
2" x 4"	16"	10' 0"
2" x 4"	12"	11' 0"
2" x 6"	20"	14' 6"
2" x 6"	16"	15' 4"
2" x 6"	12"	16' 7"
2" x 8"	20"	19' 0"
2" x 8"	16"	20' 2"
2" x 8"	12"	21' 8"

NOTE. Where the attic space above ceiling joist is unfinished but is usable for storage space, or if the space is suitable for finishing in the future, the spans for ceiling joists shall be figured the same as floor joists.

HOW TO INSTALL BRIDGING

Definition. Bridging is usually composed of short pieces of 1 by 3, cut and nailed in between the floor joists (Fig. 20).

Purpose. The purpose of bridging is to stiffen the floors and help in distributing the loads more evenly.

Spacing. It is customary to insert rows of cross bridging every 5 to 8 ft. throughout the length of the beams. To be effective they

should be in straight lines or rows along the floor so that each strut may abut directly opposite those adjacent to it.

Construction. Bridging should be cut and nailed into place at the top only (Fig. 20), just as soon as the joists are all in place and

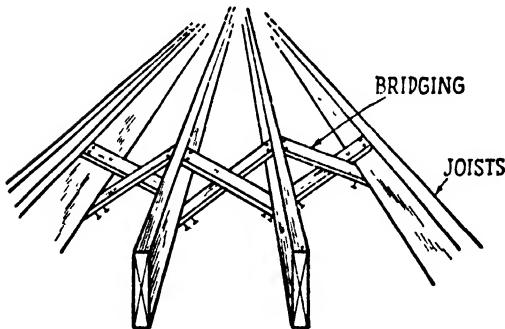
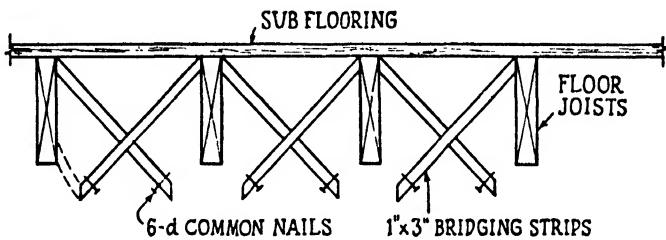


Fig. 20.—The purpose of bridging is to stiffen the floors and help in distributing the loads more evenly. Bridging should be cut and nailed into place at the top only as soon as all joists are in place and before any flooring is nailed onto the joists.

before any flooring is applied. Leaving the lower ends loose until all the subfloor is nailed on is advisable because placing the subfloor will tend to bring the tops of all the joists into alignment. As soon as the subfloor is in place, the bridging should be nailed at the bottom.

HOW TO LAY SUBFLOORING

Definition. Subflooring is the first floor laid over the floor joists. It is usually of common material—such as, 1- by 8-in. square-edge box or 1- by 8-in. shiplap yellow pine. It is also possible to obtain subflooring in matched-edge and matched-end material.

Purpose. The purposes are manyfold:

1. To provide a working floor
2. To strengthen construction
3. To provide a base for a finish floor
4. To provide additional deadening material
5. To increase insulation from the basement

Size. Subflooring is usually $1\frac{3}{16}$ by 6 in., 8 in., or 10 in. wide, and in lengths suitable for convenient use.

How to lay. There are two generally used methods of laying subfloor:

1. The first is to place and nail the flooring squarely across the joists.
2. The other is to place and nail the flooring diagonally across the joists.

Of the two methods, it is more economical to lay the floor square across the joists because it takes less labor. It is easier to cut, takes less time, and wastes less material. It has one disadvantage, however, in that the finish floor can be laid only at right angles to it.

Diagonal subflooring is much more difficult to lay because each piece needs to have two diagonal cuts, one at each end. These, of course, are made over the joists and naturally cause a waste of material and a loss of time. However, a diagonally laid floor is considered stronger and also gives a choice of laying the finish floor in either direction. All subflooring should be nailed at every joist. Flooring up to 6 in. wide should be nailed on with two $8d$ common nails, and flooring up to 10 in. wide should be nailed on with three

8d common nails. All joints should be made directly over the joists unless end-matched material is being used.

SOLE PLATES

Definition. Floor plates or sole plates are horizontal members, usually 2- by 4-in. pieces, placed at the bottom of a frame wall or stud partition (Fig. 21).

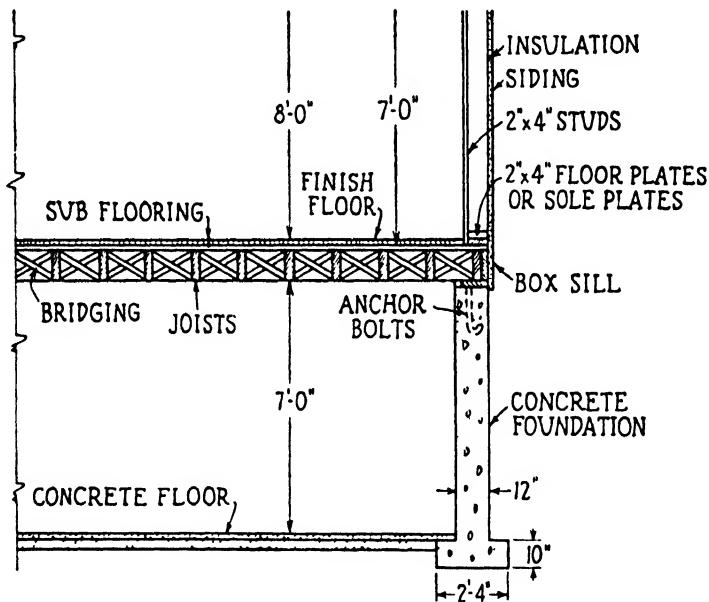


Fig. 21.—Floor and wall construction showing location of floor plates or sole plates.

Purpose. Their purpose is to carry the studs.

Size. They are usually the same size and width as the studs.

Construction. Floor plates or sole plates are used in platform construction, under stud walls, where the studs do not rest on walls or beams, or do not pass through the floor to the sill plate below. Floor plates are usually nailed directly to the subflooring.

TOP PLATES

Definition. A top plate is the horizontal member found at the top of the partition or frame wall (Fig. 22).

Purpose. Its purpose is to form a cap for the studs and also a plate or support for the ceiling joists and rafters. Sometimes it also serves as a support for other studs, either in gable ends or on second floors.

Size. The plates are always of the same material and size as the studs, except, of course, in length. Lengths may vary as requirements demand.

How to construct. It is customary to construct a double plate around the top of all walls and partitions. This provides a good bearing wall and also makes it possible to secure a good lap joint at corners and partition intersections. The plates should be spiked onto the ends of the studs with two $16d$ common nails. Each plate should be nailed on separately.

HOW TO BUILD STUD WALLS

Definition. Studs are the vertical members or pieces that go to make up the outside walls and all partitions. They are supported by the floor sole plate and, in turn, support the top plates (Fig. 22).

Purpose. They form a definite part of the construction of the house, or framework. They support the weight of the upper part of the house or everything above the top-plate line. They form the framework to which is nailed the wall sheathing on the outside. On the inside they support the lath and plaster and insulation.

Size. Except in special cases or lengths greater than 14 ft., 2- by 4-in. studs will be strong enough. Most modern construction in platform framing will require 8-ft. studs per floor. The type of framing will determine the length of the studs.

Spacing. The standard spacing for studs is 16 in. This is to enable the use of lath that has a standard length of 4 ft. This is

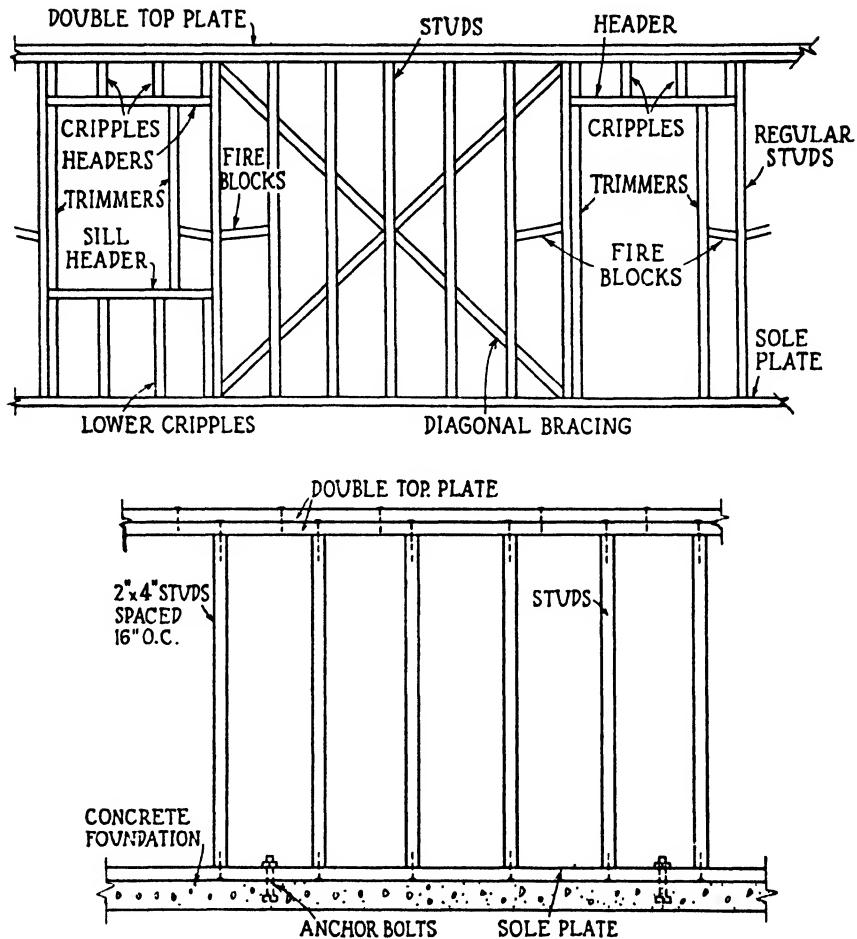


Fig. 22.—Sole plate and first top plate are nailed to studs.

necessary in all construction designed to carry lath and plaster. However, there are some places where longer spacing is permissible, for example, in garages (Fig. 23), summer cabins, etc., where other than plaster is used inside.

How to build stud walls. Usually, sections of stud walls are constructed at one time flat on the floor and then raised into place.

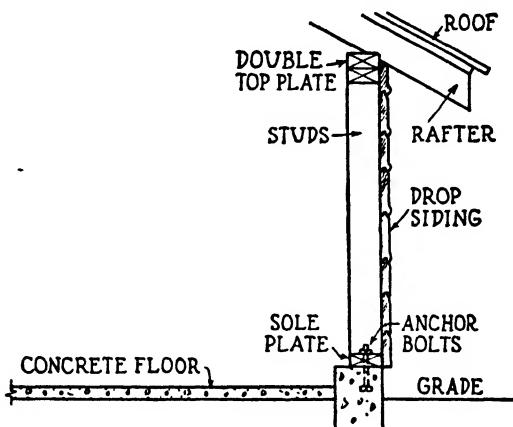


Fig. 23.—Summer cabins and smaller buildings may have siding nailed directly on the studs.

This enables the builder to lay off and space them in an easy way. It also enables him to nail the floor plate and top plate on better by spiking through the plates into the ends of the studs. This method usually results in a better job because it avoids toenailing at the sole plate.

In selecting lumber for studs, choose straight uniform material, as it makes a wall that is more free from hollow places and bulges. After a wall is erected, take care to see that each section is well tied, or braced, and that it is plumb in all directions. After all walls are erected, the double top plate should be nailed in place.

HOW TO BUILD CORNER STUDS AND PARTITION STUDS

Definition. Studs used at the corners of a building are usually built up of more than one ordinary stud.

Purpose. Generally speaking, their purpose is the same as the regular studs.

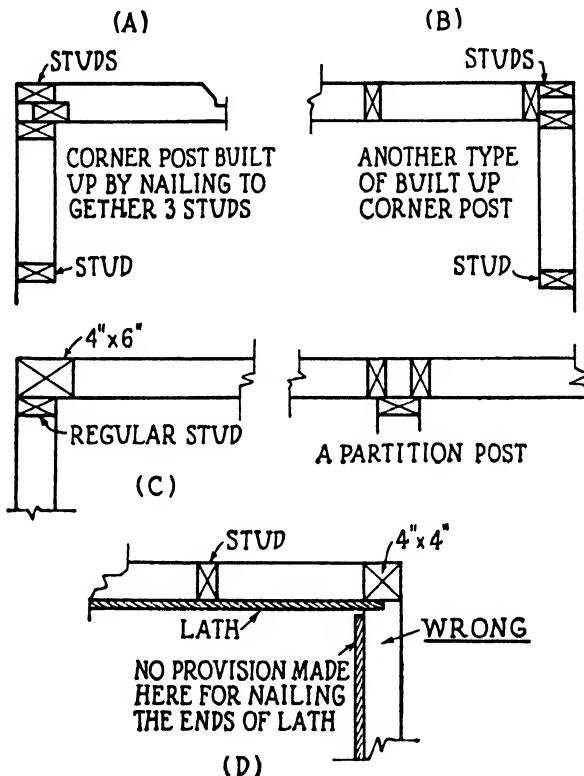


Fig. 24.—Corner posts or studs occur at the intersection of two walls at right angles with each other. They should be built so that the ends of all laths can be securely nailed to them.

Size. The sizes are the same as those of the regular studs, except as increased by building up.

Construction. Several types of corner studs and their methods of

building up are shown in Fig. 24. Corner studs should be framed in and raised along with the regular stud wall.

Figure 24*A* is perhaps the most simple and most satisfactory in common use today; *B* does not provide so much surface for nailing the lath as *A*; *C* and *D* are sometimes used, but both require material special to ordinary construction.

WINDOW AND DOOR HEADERS

Definition. Wherever doors and windows occur, parts of the stud wall must be cut away. Thus it becomes necessary to install pieces called "headers" over the opening to support the lower ends of the studs that have been cut off (Fig. 25). If it is a window, there will be a similar piece at the bottom called a "rough sill." This, of course, is to pick up the remaining pieces of studs that have not been cut out.

Purpose. The purpose is to support the studs that have been cut away and to construct a strong frame into which a doorjamb or window frame may be fitted.

Size. In order to determine the size of headers, first determine whether or not they are load-bearing or nonload-bearing. If they are nonload-bearing and not more than 3 ft. wide, a single 2 by 4 will make a satisfactory header (Fig. 26). However, inside trim is sometimes too wide to nail satisfactorily, and wider headers are needed for this purpose only.

If they are load-bearing walls, all the headers should be doubled and rest on studs, as shown in Figs. 27 to 29. The 2 by 4's used for headers should be laid on edge vertically side by side with a piece of lath inserted between them to make them full $3\frac{5}{8}$ in. thick, or the same as the stud.

Spacing. Be sure to allow sufficient space in the rough opening for doorjambs or window frames to be installed with ease and to be plumbed and leveled.

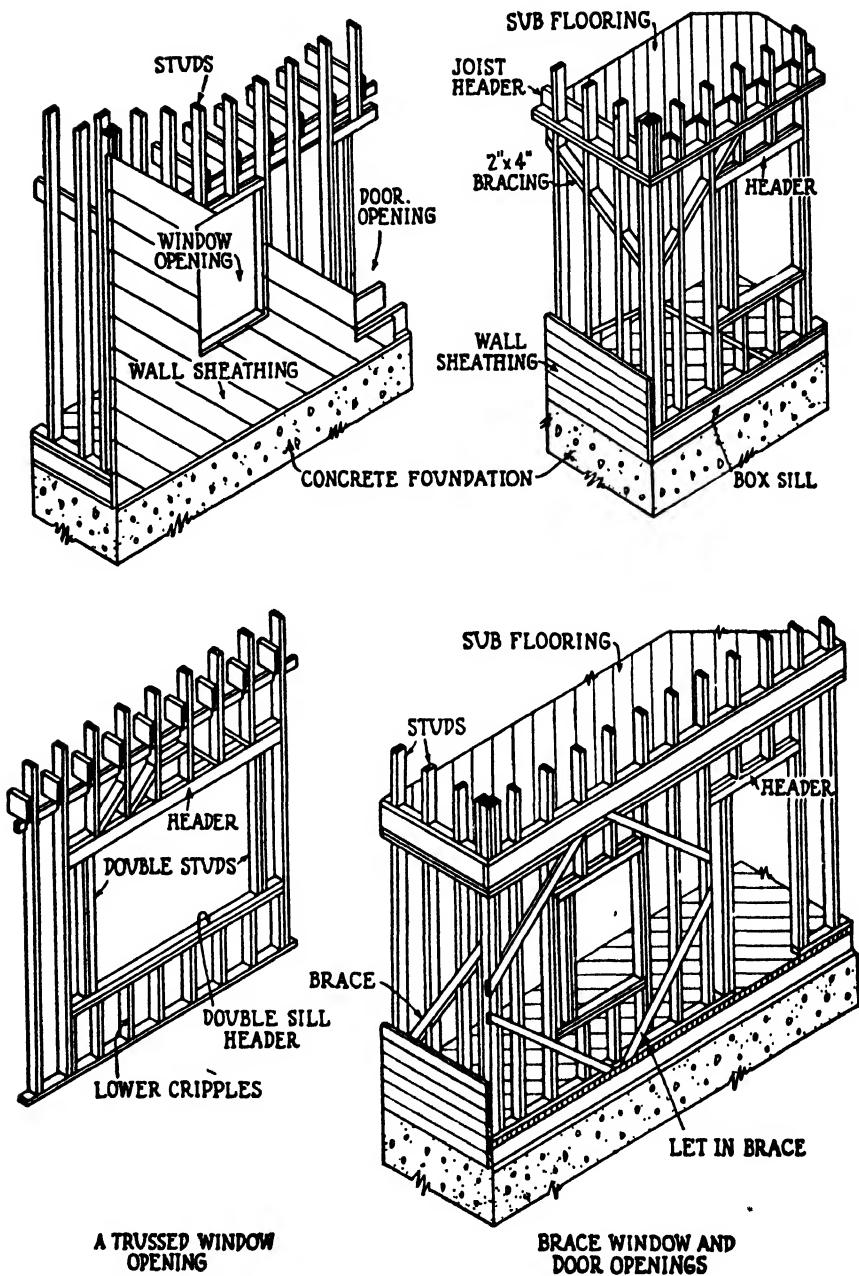


Fig. 25.—Typical wall constructions showing window and door headers.

WHERE TO USE TRUSSES

Definition. Trusses are arrangements of framing material so constructed as to divert the weight at a given point to some other place.

Purpose. They are used over openings where doors or windows occur to shift the weight to the sides of the openings and thus prevent sagging of the wall above and cracking of the plaster.

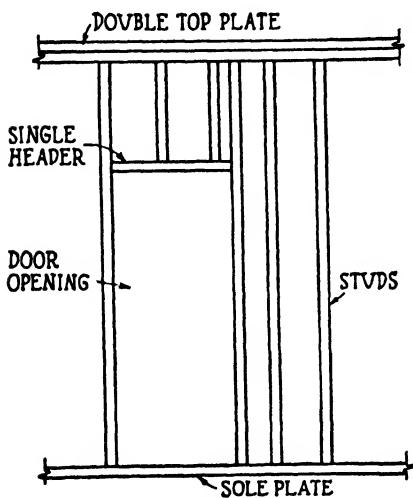


Fig. 26.—Openings that are nonload-bearing need not have double headers. These occur only in small openings. Regular studs are always placed 16 in. on center. Extra studs are used at the sides of all openings. Studs are spaced 16 in. O.C. in order to pick up lath.

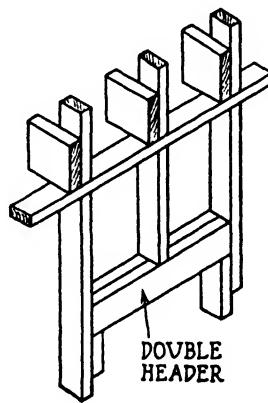


Fig. 27.—Openings that are load-bearing should always be double headed. If 2 by 4's are used on edge, spacers of lath or thin pieces of wood are used to make the header as thick as the studs.

Sizes. For all openings of 3 ft. or over the header will need to be trussed. There are several arrangements of trusses. Figure 28 shows an arrangement widely used in the trade and very satisfactory. Figure 29 shows a truss arrangement over an opening 6 to 8 ft. wide. This type is generally used over wide doors and group windows.

WALL SHEATHING

Definition. Outside wall sheathing is generally the same material as that used for subfloors. It is nailed directly to the outside

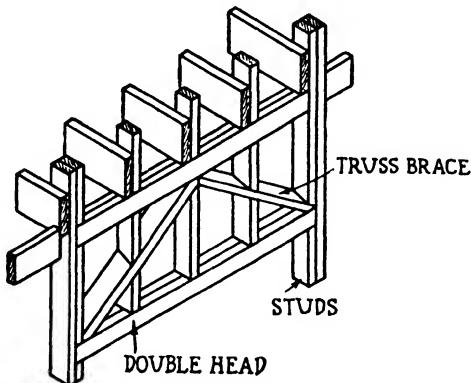


Fig. 28.—Openings that have extreme weight are to be trussed. This diverts the weight from the center to the outside at the studs.

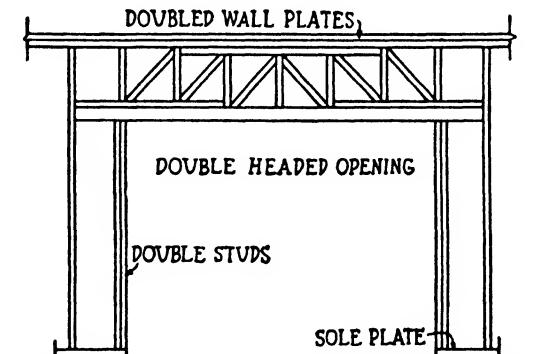


Fig. 29.—For all openings of 3 ft. or more, the header will need to be trussed. There are several arrangements of trusses. This type is generally used over wide doors and group windows.

of the studs. It may be nailed on square across the studs or diagonally. By nailing diagonally, of course, much greater strength is obtained.

Purpose. Its purpose is to strengthen the building, give a base wall onto which the finished siding or wall can be nailed, and provide a certain amount of insulation against heat or cold (Fig. 30).

Size. Like subflooring, wall sheathing can be obtained in most widths and lengths. Generally used, however, are widths from 8 to

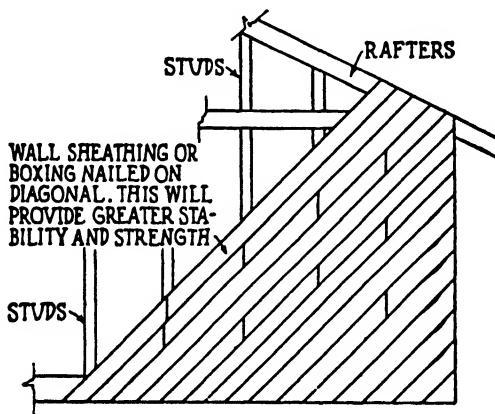


Fig. 30.—Application of wall sheathing.

10 in. with lengths selected for economical use. Most wall sheathing used is $1\frac{3}{16}$ in. thick and of either square-edge box or shiplap. Material should be nailed on with three $8d$ common nails, if pieces are over 6 in. wide.

Spacing. Wall sheathing should be laid tight, and all joints made over the studs. Start at the foundation and work up.

ROOF SHEATHING

Definition. Roof sheathing is the term applied to that material or the boards that are nailed directly to the rafters.

Purpose. The purpose of roof sheathing is to provide a subsurface on which to nail shingles or the finished roof. It ties together the rafters, stiffens the building, and acts largely in the same capacity that subflooring and subsiding do. It also provides a certain amount of insulation, especially in the solid or tight-deck type (Fig. 31).

Size. Sizes for tight deck will be the same as for subflooring and subsiding. Where wood shingles are used, strips for sheathing are generally used also. These strips vary in size from 1 by 3 to 1 by 4 to 1 by 6.

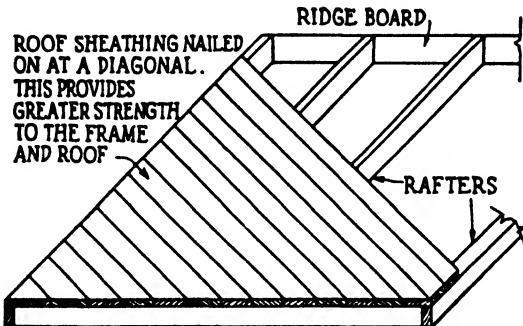


Fig. 31.—Tight-deck-type roof sheathing.

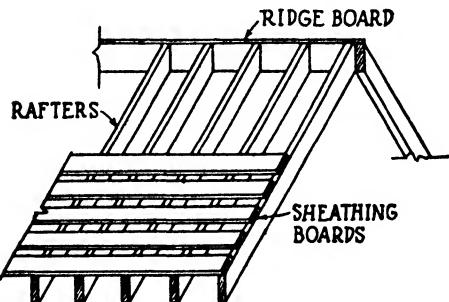


Fig. 32.—Roof sheathing is the term applied to the material or boards that are nailed directly on the rafters. Its purpose is to provide a subsurface on which to nail the shingles or the finished roof. Space the boards as far apart on centers as the shingle is laid to the weather.

Spacing. It is necessary, however, in using these to space them as far apart on centers as the shingle is laid to the weather (Fig. 32).

How to apply. In starting to put on sheathing one should start at the eaves with one good-quality wide board. The boards should be nailed at every rafter with two $8d$ common nails; if sheathing boards are over 6 in. wide, they should be secured with three nails each.

BUILDING PAPERS

Definition. Building paper is a special strong, heavy, waterproof paper used to nail on subfloors between the subfloor and the finish floor. It is used to nail on wall sheathing between the sheathing and the finished outside walls, such as weatherboarding, wall shingles,

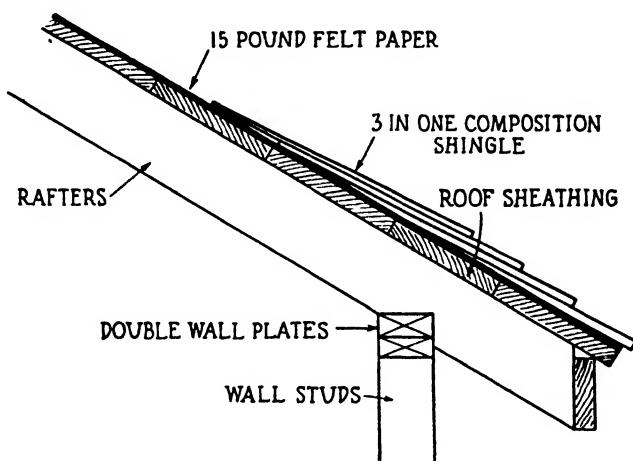


Fig. 33.—Use of felt building paper on roof.

and brick veneer. It is used to nail on the roof sheathing between the sheathing and the finish roof (Fig. 33).

Where to use. Its use in all places is about the same. If properly applied, it prevents wind and air filtration.

1. **FLOORS.** On floors building paper prevents air and dust from the basement from sifting into the house through cracks. It also prevents moisture from the basement or any other source from entering the finish floor by absorption and thus guards against the swelling or buckling of the floors that would naturally result from this action. It also has some insulating value and sound-deadening effect, but not a great deal, as it is too thin.

2. **WALLS.** Of course the same principles apply to the outside walls of a building as to the floor. The principal purpose of building

paper is to prevent air, wind, dust, and moisture penetration from the outside (Fig. 34).

3. Roof. Its purpose on a roof would be, of course, the same as on the floors and side walls. It adds, in this case, a double protection against leakage.

Size. Building paper comes in rolls usually from 200 to 500 sq. ft. in area. Weights will vary from 20 up to 75 lb. per square (a

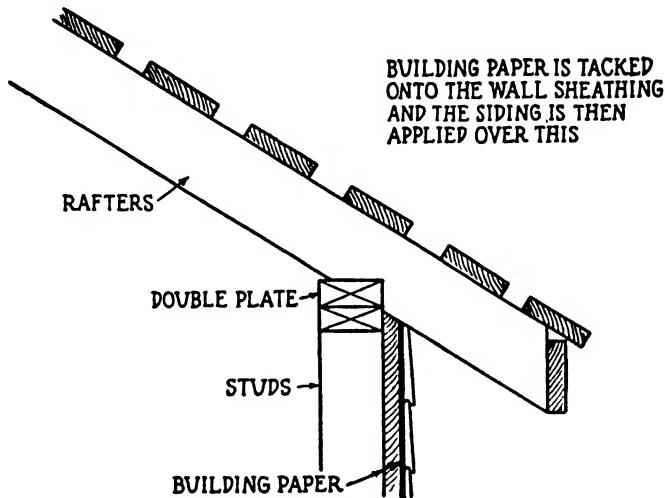


Fig. 34.—Use of building paper on wall.

square = a surface 10 ft. square, or 100 sq. ft.). Thus, if a roll of paper was listed as a 500-ft. roll of 20 lb. weight, it would indicate that the roll contained 5 squares of paper and would weigh 100 lb. Table 4 indicates how average papers are listed and sold.

Spacing. When applied to a building, all papers should have a sufficient lap which should never be less than 3 in. Sometimes it is as much as half the width of the paper.

How to apply. Smooth out the paper to prevent bulges, humps, and bad joints. It is generally nailed on with common galvanized roof nails or with nails that have been supplied by the manufacturer. It is usually a good policy to follow the manufacturer's directions in applying building paper.

TABLE 4.—BUILDING PAPERS

<i>Kind</i>	<i>Description</i>	<i>Sq. ft.</i>	<i>Weight, lb.</i>
Slater's felt.....	Used under slate or tile	500	30
Red rosin paper.....	Used over sheathing	500	20
Red rosin paper.....	Used over sheathing	500	30
Red rosin paper.....	Used over sheathing	500	40
Black insulating.....	Waterproofed, used over sheathing	250	15
Black insulating.....	Waterproofed, used over sheathing	500	30
Black insulating.....	Waterproofed, used over sheathing	500	45
Deadening felt.....	Used under floors and linoleum	450	60
Deadening felt.....	Used under floors and linoleum	500	75
Duplex sheathing.....	Double sheets cemented with asphalt	500	20
Roof sheathing.....	Used under all kinds of shingles	200	50

2

R A F T E R F R A M I N G

Rafters are those members of a roof that extend from the plate to the ridge or any part thereof. They serve the same purpose for the roof as the floor joists do for the floors (Fig. 35), that is, to form a framework or construction that will provide a support for the roof sheathing and roofing material.

The size of a rafter usually depends upon the following:

1. The span
2. Kind of roof material to be used
3. Wind
4. Snow
5. Type of architecture

Maximum spans for wood rafters are given in Table 5. Spacings of rafters from 16 to 24 in. are common in small frame construction. Sometimes 20 in. is used, but with the use of 1-in. sheathing this is not always advisable, as the sheathing becomes too flexible at this distance. Plastering directly to the rafters from under is seldom done; however, if desired, the rafters should be spaced 16 in. on center.

TABLE 5.—MAXIMUM CLEAR SPANS OF RAFTERS FOR ROOFS WITH
A MINIMUM SLOPE OF 5 TO 12

For wood and asphalt shingle roofs

Assumed total live and dead load, 40 lb. per sq. ft.

Nominal	Actual	Spacing center to center	Maximum clear span *		
			Minimum fiber stress, 1,200 lb.	Minimum fiber stress, 1,000 lb.	Minimum fiber stress, 1,000 lb.
		<i>Douglas fir (coast region and Inland Empire) southern yellow pine, western larch</i>		<i>West coast hemlock, cy- press, red- wood, tamarack</i>	<i>All other soft woods</i>
2" x 4"	1 $\frac{5}{8}$ " x 3 $\frac{5}{8}$ "	24"	6' 6"	6' 1"	5' 1"
		20"	7' 3"	6' 7"	5' 6"
		16"	8' 1"	7' 4"	6' 2"
		12"	9' 4"	8' 6"	7' 2"
2" x 6"	1 $\frac{5}{8}$ " x 5 $\frac{5}{8}$ "	24"	10' 3"	9' 4"	7' 8"
		20"	11' 4"	10' 5"	8' 8"
		16"	12' 6"	11' 5"	9' 6"
		12"	14' 2"	13' 1"	11' 0"
2" x 8"	1 $\frac{5}{8}$ " x 7 $\frac{1}{2}$ "	24"	13' 8"	12' 6"	10' 0"
		20"	15' 2"	13' 8"	11' 0"
		16"	16' 7"	15' 3"	12' 1"
		12"	18' 4"	16' 7"	14' 3"

NOTES. Rafters for slate, tile, or asbestos-cement (rigid) shingle roofs must be of sufficient size to carry the load.

Where the allowable fiber stress of the species of wood used is in excess of 1,200 lb., increased spans will be permitted, provided they are determined on the same basis as those used for this table.

Rafters on roofs with slopes less than 5 to 12 should be figured the same as floor joists.

* The distance measured horizontally from the plate to a point directly beneath the ridge. The actual rafter length will depend upon the roof slope and must be determined accordingly.

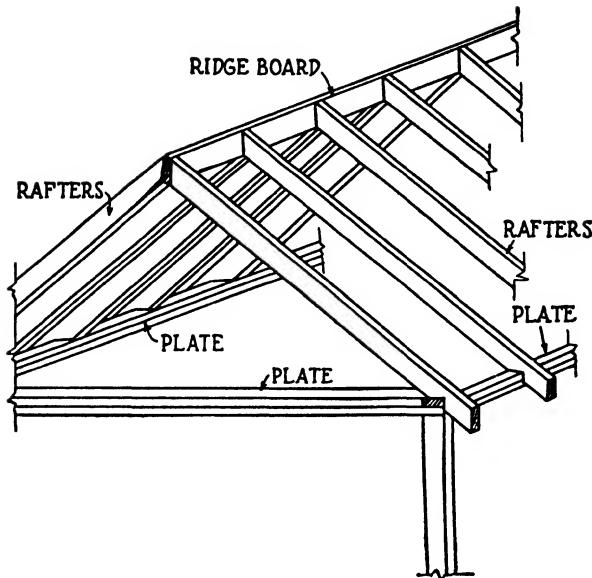


Fig. 35.—The purpose of rafters is to form a framework or construction that will provide a support for the roof sheathing and roofing.

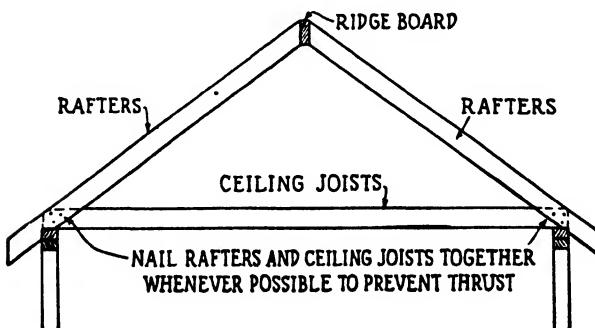


Fig. 36.

Every effort should be made to reduce all outward thrust. If rafters are spaced the same as ceiling joists, they can be spiked together at the plate (Fig. 36).

It is always desirable to use a ridgeboard, which helps in the erection and alignment of the rafters (Fig. 36).

The rafters should be notched over the plate and have a plate bearing of not less than 3 in. (Fig. 37). Care should be taken at all times to maintain a level ridge. Whenever possible, collar beams should be employed to reduce span and rafter thrust.

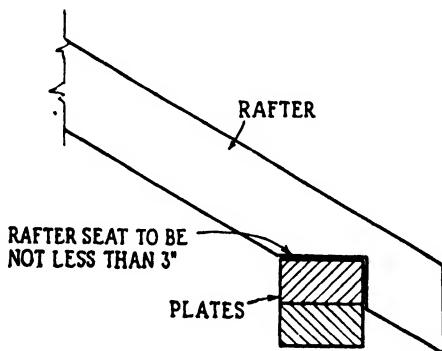


Fig. 37.—Rafter seat or bearing on plate should be not less than 3 in.

Types of roofs. The most usual types of roof construction are as follows:

1. **GABLE ROOF.** This is the most commonly used type. It has two roof slopes meeting at the center or ridge to form a gable. It is a good roof, usually trouble-free and easy to construct (Fig. 38).

2. **LEAN-TO OR SHED TYPE.** This type with only one slope is usually built next to or against another building. It is one of the least expensive roofs to build and is generally found in cheap construction (Fig. 39).

3. **HIP ROOF.** This type of roof consists of four sides or slopes, all running toward the center of the building. Rafters at the corner run up diagonally to meet at the center or ridge. Into them other rafters are framed (Fig. 40).

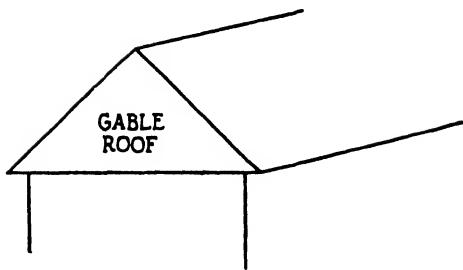


Fig. 38.

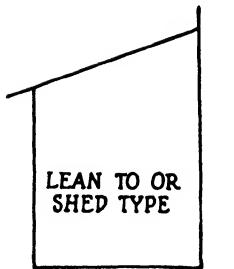


Fig. 39.

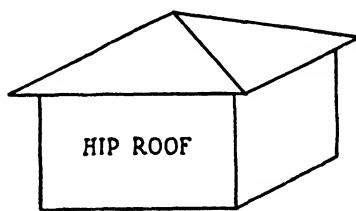


Fig. 40.

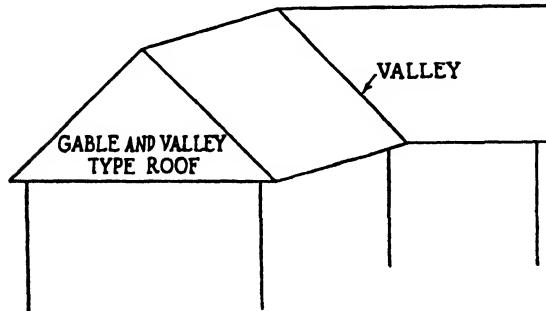


Fig. 41.

4. **GABLE AND VALLEY.** This is a combination of two gable roofs intersecting each other. The valley is the place where the two meet, each roof, of course, slanting in a different direction (Fig. 41).

Framing terms. In order to more clearly understand roof framing, we must first be familiar with the following terms, which the building trades student should commit to memory:

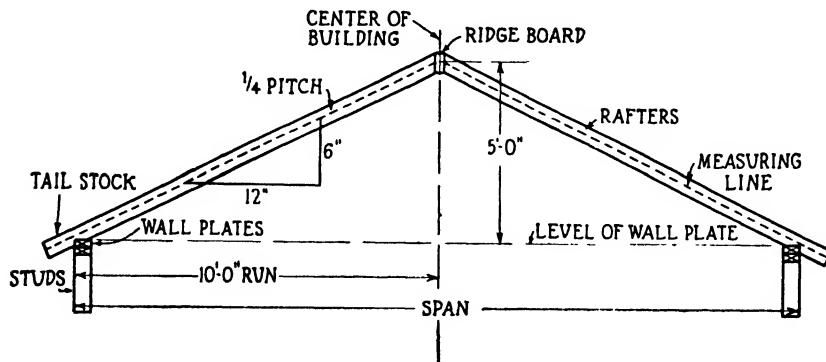


Fig. 42.—Illustration of framing terms.

1. **SPAN.** The span of a roof is the distance between the outside corners of the wall plates (Fig. 42).

2. **RUN.** The run of a roof is the shortest horizontal distance measured from a plumb line passing through the center of the ridge to the outer edge of the plate (Fig. 42). The run is always equal to half the span, provided the building is of equal pitch.

3. **RISE.** The rise of a roof is the *vertical* distance from the top of the plate to the upper end of the measuring line or equal point on the ridge (Fig. 42).

A simple rule to follow for finding the rise of a roof when the pitch is known is

Multiply the pitch by the span.

Example. A building is 24 ft. wide. The roof pitch equals $\frac{1}{3}$. What is the rise?

Solution. Rise equals $\frac{1}{3} \times 24$ ft., or 8 ft.

4. PITCH. The pitch of a roof is the slant or slope from the plate to the ridge. It is usually expressed in terms of the ratio of the total rise to the total width of the building. Thus, if a building has an 8-ft. rise and a 24-ft. span, we would say $8 \div 24 = \frac{1}{3}$, or $\frac{1}{3}$ pitch (Fig. 43).

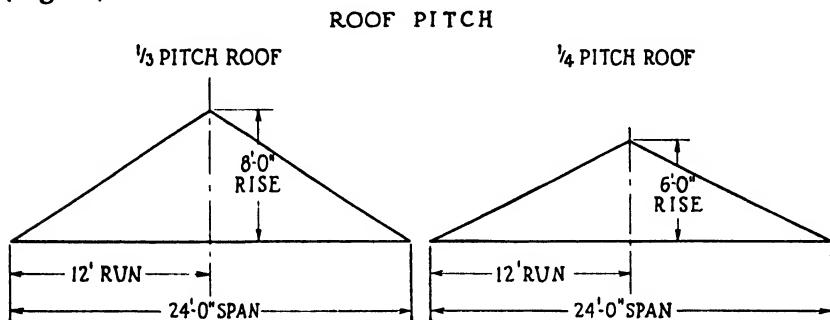


Fig. 43.

A simple rule for finding the pitch of a roof is

Divide the rise by the span.

Example. A building is 24 ft. wide (span). The rise of the roof is 8 ft. What is the pitch?

Solution. Pitch equals $8 \div 24 = \frac{1}{3}$, or $\frac{1}{3}$ pitch.

Principal roof pitches. The principal roof pitches are generally called “ $\frac{1}{2}$ pitch,” “ $\frac{1}{3}$ pitch,” and “ $\frac{1}{4}$ pitch.” The rise for $\frac{1}{2}$ pitch equals one-half the distance of the span; for $\frac{1}{3}$ pitch, one-third the span; and for $\frac{1}{4}$ pitch, one-fourth the span.

If we stand a steel square on a table, with the body up and the tongue resting on the table, and construct a line from the figure 24 on the body to the figure 12 on the tongue, we have a slant or slope representing 1 pitch (Fig. 44). If we draw the line from 12 on the body to 12 on the tongue, we have a slant equal to $\frac{1}{2}$ pitch (Fig. 45). If we draw the line from the figure 8 on the body to the figure 12 on the tongue, we have a slant equal to $\frac{1}{3}$ pitch (Fig. 46).

Thus figures on the body represent the inches of rise, and the 12 on the tongue represents 1 ft. of run. Thus a roof rises so many

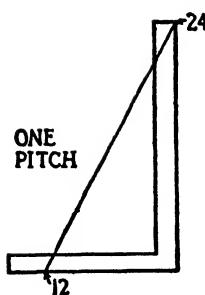


Fig. 44.

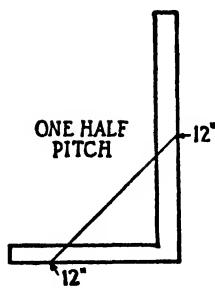


Fig. 45.

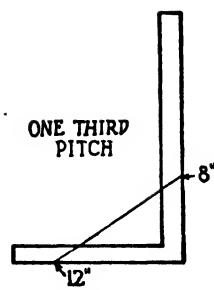


Fig. 46.

Figs. 44-46.—The principal roof pitches are generally called $\frac{1}{3}$, $\frac{1}{2}$, and $\frac{1}{4}$. This means that the rise for $\frac{1}{3}$ pitch would equal $\frac{1}{3}$ the span. One-half pitch would equal $\frac{1}{2}$ the span and $\frac{1}{4}$ pitch would equal $\frac{1}{4}$ the span.

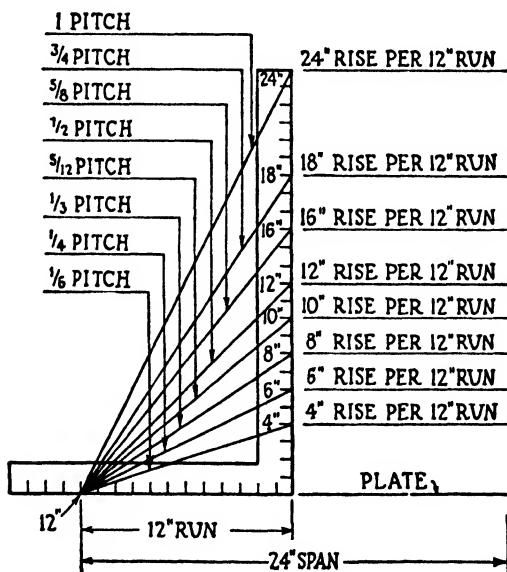


Fig. 47.

inches for each foot of run, and the number of inches it rises for each foot of run determines the pitch. For example, if 24 in. on the body and 12 in. on the tongue represent 1 pitch; 6 in. on the body would be $\frac{6}{24}$ of 1 pitch or $\frac{1}{4}$ pitch; 8 in. on the body would be $\frac{8}{24}$ of 1 pitch or $\frac{1}{3}$ pitch; 12 in. on the body would be $\frac{12}{24}$ of 1 pitch or

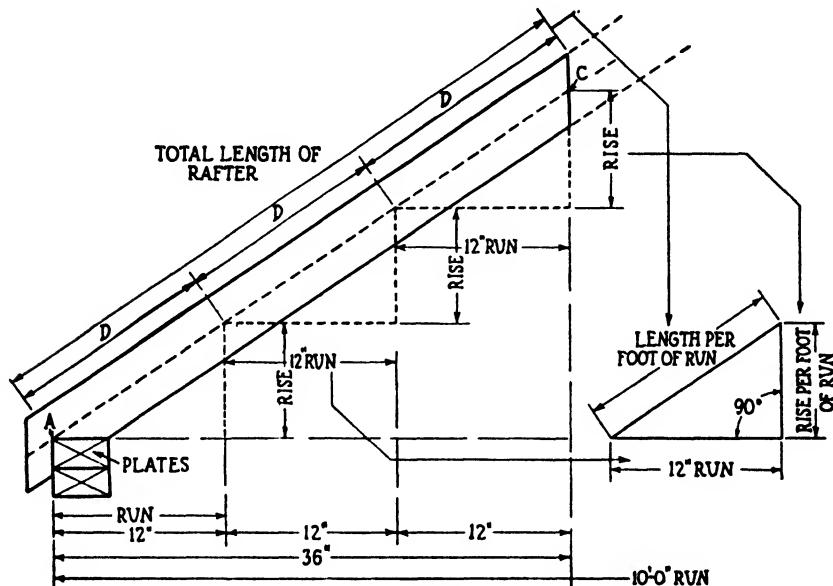


Fig. 48.

$\frac{1}{2}$ pitch; 18 in. on the body would be $\frac{18}{24}$ of 1 pitch or $\frac{3}{4}$ pitch, etc. (Fig. 47).

Length per foot of run. Rafter tables found on a steel square are based on *rise per foot of run*; that is, the figures in the tables indicate the length of the rafters per 1-ft. run of common rafters for any rise of roof. Therefore, if the run of a building is 10 ft., the length of the rafter will be 10 times the figure listed under the rise (see Fig. 48). The roof has a 20-ft. span and any given rise per foot. The figure is a right triangle, ABC , with the run, rise, and rafter as its sides. The run of the rafter is 10 ft. This being divided into 10 parts, each will represent a 1-ft. run. If vertical lines are drawn through these points, you will find that the rafter is also divided

into 10 equal parts marked *D*. Since each section *D* represents the length of the rafter per foot of run and the total run of the rafter equals 10 ft., the rafter would be as long as 10 times *D*. By this method the length of any rafter for a building of any width can be determined. The length per foot of run will be different for different-pitched roofs. In order to find the length of the rafter you must first know the rise per foot of run.

A simple rule for finding the number of inches rise per foot of run (Fig. 49) is as follows:

Multiply the rise in feet by 12 and divide by the length of run in feet.

Example. Find the rise per foot of run of a roof whose span is 36 ft., run is 18 ft., rise is 12 ft. $12 \times 12 \div 18 = 8$ or 8-in. rise per foot.

Kinds of rafters. The different kinds of rafters are as follows: (1) common rafter; (2) hip rafter; (3) valley rafter; (4) jack rafter (hip jacks, valley jacks, cripple jacks).

COMMON RAFTERS are those that extend from the plate to the ridge at right angles.

HIP RAFTERS are those that extend from the corner of the plate to the ridge diagonally.

VALLEY RAFTERS are those extending diagonally from the plate to the ridge at a point where two roofs intersect.

JACK RAFTERS are those that do not extend from the plate to the ridge. *Hip jacks* are those whose lower ends rest on the plate and the upper ends rest against a hip rafter. *Valley jacks* are those whose upper ends rest against the ridgeboard and whose lower ends rest against a valley rafter. *Cripple jacks* are those whose upper and lower ends touch neither the plate nor the ridge but are nailed in between a hip and a valley rafter.

For examples of rafters, see Fig. 50.

Rafter cuts and terms. In order to understand rafter framing thoroughly you should also know the various cuts found on rafters and the places to find them (Fig. 51).

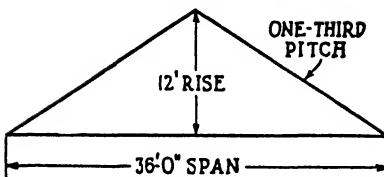


Fig. 49.—A simple rule for finding the number of inches rise per foot of run.—Multiply the rise in feet by 12 in. in order to obtain the total number of inches in the rise. Divide the total number of inches in the rise by the length of run in feet. This will give the rise per foot of run.

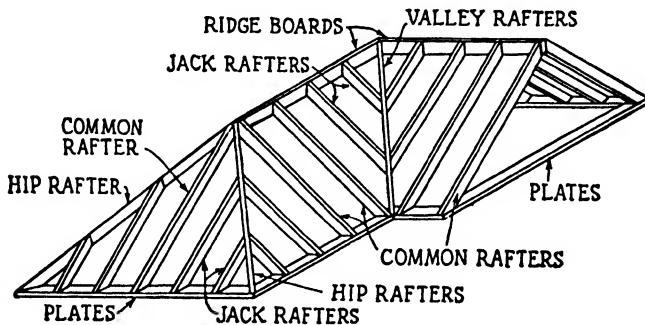


Fig. 50.—A roof frame.

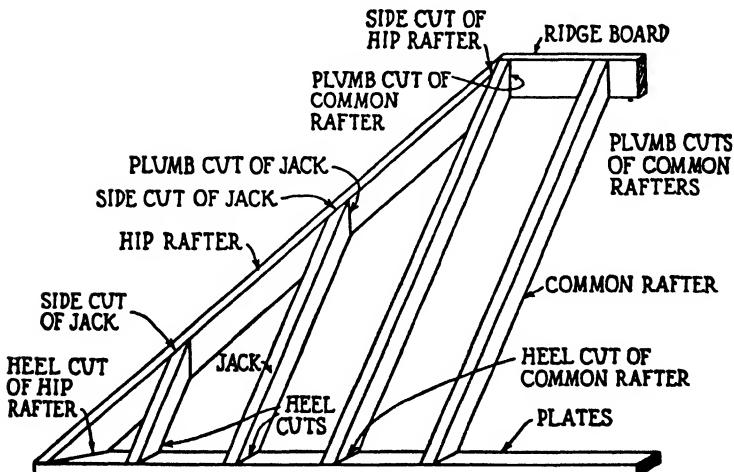


Fig. 51.—Rafter cuts and terms.

THE TOP CUT or PLUMB CUT is the end that is placed against the ridgeboard at the ridge. If the ridge is omitted, it rests against the opposite rafter.

THE SEAT CUT, sometimes called the "bottom" or "heel" cut, is the end that rests on the plate.

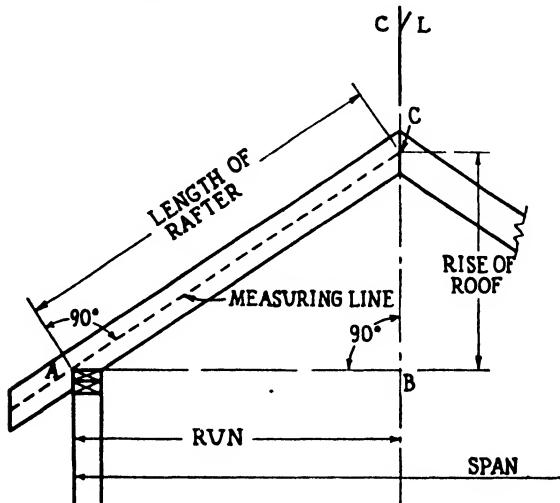


Fig. 52.—Measuring line of rafter.

THE SIDE CUTS, sometimes called "cheek" cuts, are those made on a bevel at the side of a rafter so that they will fit against other members of the roof frame.

THE LENGTH of a rafter is the shortest distance between the outer edge of the plate and the center of the ridge line.

THE EAVE or TAIL is the part of the rafter that extends out past the outside corner or edge of the plate. It is never figured in determining the length of a rafter but must be considered in buying the material. The amount is determined from the plans or type of cornice to be used.

THE MEASURING LINE is an imaginary line drawn down the middle of the face of a rafter parallel to the edges. This line measures the length of the rafter (Fig. 52). If we let a right triangle represent the roof *ABC* (Fig. 53), the measuring line is the hypotenuse or the longest side. The other two sides are the rise and the run.

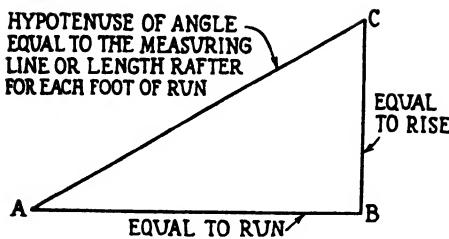


Fig. 53.

23	22	21	20	19	18
LENGTH OF COMMON RAFTER PER FOOT OF RUN				21.63	
LENGTH OF HIP OR VALLEY PER FOOT OF RUN				24.74	
DIFFERENCE IN LENGTH OF JACKS 16" ON CENTER				28.84	
DIFFERENCE IN LENGTH OF JACKS 24" ON CENTER				43.27	
FOR SIDE CUTS OF JACKS USE				6 ¹¹ / ₁₆	
FOR SIDE CUTS OF HIPS OR VALLEYS USE				8 ¹ / ₄	
22	21	20	19	18	17

17	16	15	14	13	12
20.81	20.00	19.21	18.44	17.69	16.97
24.02	23.32	22.65	28.00	21.38	20.78
27.74	26.66	25.61	24.585	23.588	22.625
41.62	40.00	38.42	36.88	35.38	33.94
6 ¹¹ / ₁₆	7 ³ / ₁₆	7 ¹ / ₂	7 ¹¹ / ₁₆	8 ¹ / ₈	8 ¹ / ₂
8 ¹ / ₂	8 ¹ / ₄	9 ¹ / ₁₆	9 ³ / ₈	9 ⁵ / ₈	9 ¹ / ₈
16	15	14	13	12	11

11	10	9	8	7	6
16.28	15.62	15.00	14.42	13.89	13.42
20.22	19.70	19.21	18.75	18.36	18.00
21.70	20.83	20.00	19.23	18.58	17.87
32.56	31.24	30.00	28.84	27.78	26.83
8 ¹ / ₈	9 ¹ / ₄	9 ³ / ₈	10	10 ¹ / ₈	10 ¹ / ₄
10 ¹ / ₈	10 ³ / ₈	10 ⁵ / ₈	10 ⁷ / ₈	11 ¹ / ₁₆	11 ⁵ / ₁₆
10	9	8	7	6	5

Fig. 54.

How to find the length of common rafters. *To find the length of common rafters* secure a steel square with a rafter table on the face (Fig. 54). Then look on the first line below the outside edge of the blade which is marked "Length of common rafters per foot of run." Under each of the numbers on the inch line at the top edge of the blade from 2 up to 18, you will find figures given in inches and hundredths of inches, the length per foot of run of rafters whose rise per foot of run is 2 or 18 in., or any number in between. For example, if the pitch is $\frac{1}{3}$, the rise per foot of run would be 8 in. Therefore, look under the figure 8 and find 14.42 in., which is the length of the rafter per foot of run for a $\frac{1}{3}$ pitch roof. Therefore, to find the length of the common rafter multiply this length per foot of run by the actual number of feet in the run. If the run is 10 ft., $10 \times 14.42 = 144.20$, the length of the common rafter in inches. This divided by 12 gives 12.01, the length in feet. This is the actual length of the rafter. From this a deduction should be made for half the thickness of the ridgeboard, and to this should be added any additional stock for the tail rafter (Fig. 55).

How to obtain the top and bottom cuts. You will note that the top and bottom cuts are always at right angles to each other (Figs. 56 to 59). Therefore, if a large steel square is placed alongside the rafters, as in Fig. 56, the edge of the tongue will coincide with the heel cut or seat cut, and the edge of the body will coincide with the plumb cut. Therefore, line *AC* gives the *plumb cut*, and line *AB* gives the *seat cut*. However, a square is not large enough for this, so you use 12 in. on the tongue and the rise per foot on the body to obtain the respective cuts. The distance 12 in. on the tongue is merely used as a unit and is the 1-ft. run, while the figure on the blade represents the *rise* per foot of run. Both cuts are obtained by placing the square on the rafter so that the 12-in. mark on the tongue and the mark on the body that represents the rise will be at the edge of the rafter, or stock. For an example, consider a common rafter 10 ft. long with a rise per foot of run of 8 in. Find the cuts (see Fig. 59). Let the ends of the rafter be represented by points *A* and *B*. To secure the seat cut take 12 in. on the tongue and 8 in.

on the body. Lay the square on the board so that the tongue will coincide with point *A*. This is the seat-cut line. Mark along the square and cut. For the top cut lay the square on so that the body coincides with point *B*. Mark and cut. Remember that the marks 12 and 8 in. must be kept accurately at the edge of the rafter while

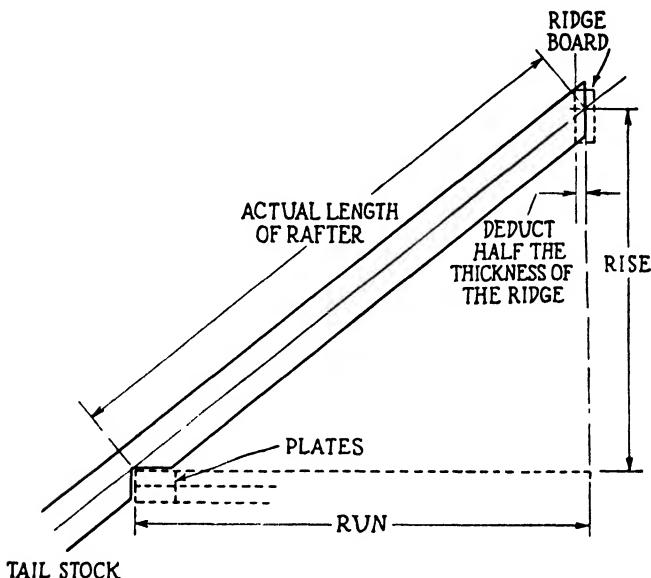


Fig. 55.—After the length of the rafter has been obtained, deduct half the thickness of the ridgeboard.

they are being located. Deduction for the ridge should be made, which is one-half the thickness of the ridge. This deduction is usually made at right angles to the plumb cut (Fig. 60). Ridgeboard deduction ensures perfect fit and good construction.

Hip and valley rafters. The hip rafter is one that forms a hip in the roof extending from the corner of the building diagonally up to the roof. The valley rafter is the same as a hip rafter except that it forms a valley where two roofs intersect.

A hip rafter may be compared to the diagonal of a square prism. Its relation to common rafters is the same as the relation of the hypotenuse of a right triangle to its sides. For example, if the two

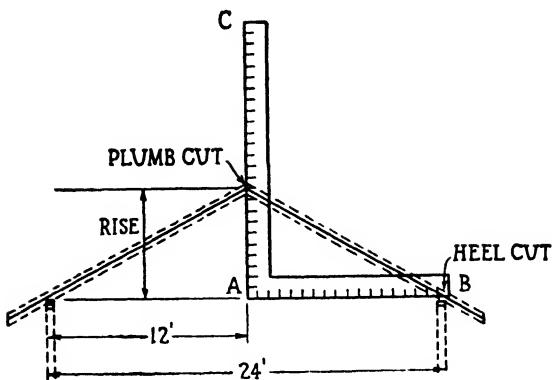


Fig. 56.

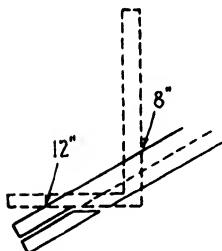


Fig. 57.

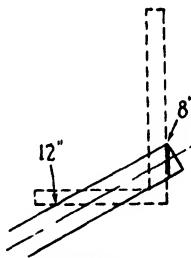


Fig. 58.

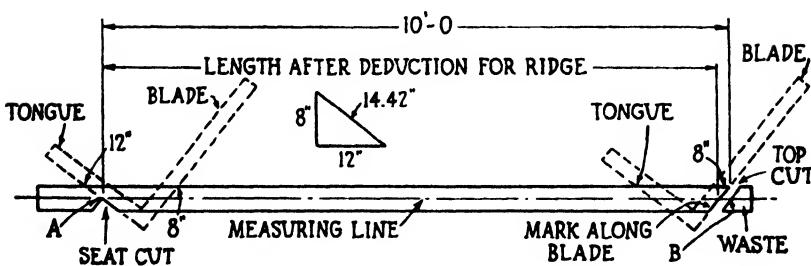


Fig. 59.

sides of a right triangle are each 1 ft., or 12 in., the hypotenuse will be 16.97 in., in rafter framing always taken as 17 in. See triangle *ABC* in Fig. 61.

The prism in Fig. 62 has a base 10 ft. square, of which one side represents the plate and the other the run of common rafter. Its height is 6 ft. 8 in., representing the rise of the roof.

Let *ACD* represent this triangle, *AC* the plate, *CD* the run of common rafter, *AD* the run of hip rafter, *CB* the common rafter, *AB* the hip rafter, *A* the corner of the building, *DB* the rise of the roof.

By taking 1 ft. of run of common rafter and 1 ft. length on the plate you will have a right triangle, whose other side represents a portion of the run of the hip rafter, which, of course, corresponds to 1 ft. of run of a common rafter. This will be 16.97 in., or commonly 17 in.

How to find the length of hip or valley rafter. Look on the second line of the rafter table marked "Length of hip or valley per foot of run" (Fig. 55) and multiply the length given there by the number of feet in the *run of the common rafter*. If the pitch is $\frac{1}{3}$, you would look under 8 and find 18.76 in the second line. If the common rafter run is 10 ft., then the hip rafter will be as long as 10×18.76 , or 187.60 in. This divided by 12 gives 15.63, the length of the hip rafter in feet.

CUTS. The top and bottom cuts can be obtained by using 17 on the tongue and the rise per foot of run on the body; 17 will give the seat cut, and the figure on the body will give the plumb cut.

MEASURING. The length of all hips and valley rafters is measured along the center of the top edge or back.

SIDE CUTS. At the ridge it is necessary to have side cuts on hip or valley rafters. Look in the last line of rafter table on the square where it is marked "For side cuts of Hips or Valleys use" (Fig. 54). The figures given in this line refer to the graduation marks on the outside edge of the body. Take this figure and 12 in. on the tongue and mark the side cut along the tongue where the tongue coincides with the point on the measuring line.

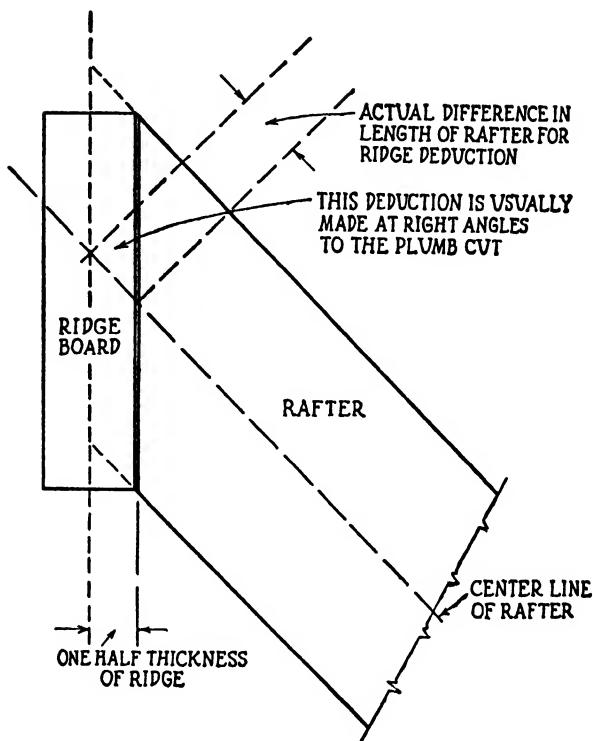


Fig. 60.

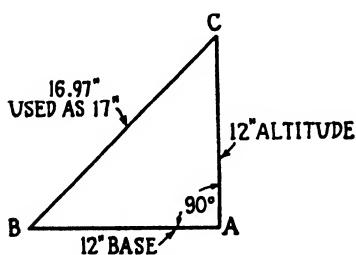


Fig. 61.

How to find the length of jack rafters. Jack rafters are common rafters cut off for some reason or other. It may be because of intersecting roofs or on hip corners, etc. (Fig. 63). Jack rafters are spaced the same, have the same pitch, and lie in the same plane as common rafters. They also have the same length per foot of run as common rafters. Jack rafters are usually spaced either 16 or 24 in. on center.

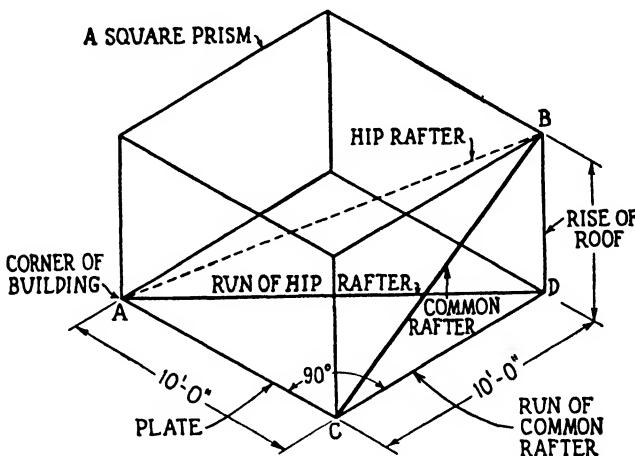


Fig. 62.

As they rest against the hip or valley on equal spaces, the second jack must be twice as long as the first; the third three times as long; etc.

If you look in the third line of the rafter table (Fig. 54), you will find "Diff. in length of jacks 16" O.C." If you look in the fourth line, you will find "Diff. in length of jacks 24" O.C." The figure given under the rise per foot of run number is the length of the first and shortest jack. The second will be twice as long, etc. Multiply the figure given in the tables by the number indicating the position of the rafter. From this length subtract half the diagonal thickness of the hip or valley.

How to make side cuts for jacks. Plumb and seat cuts for jack rafters are the same as for common rafters. Side cuts for jacks are found on the fifth line of the rafter table marked "For side cuts of

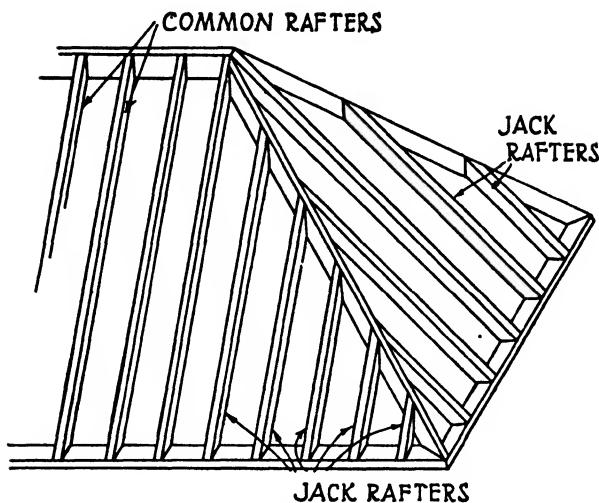


Fig. 63.—Jack rafters are common rafters cut off for some reason or other, perhaps because of intersecting roofs.

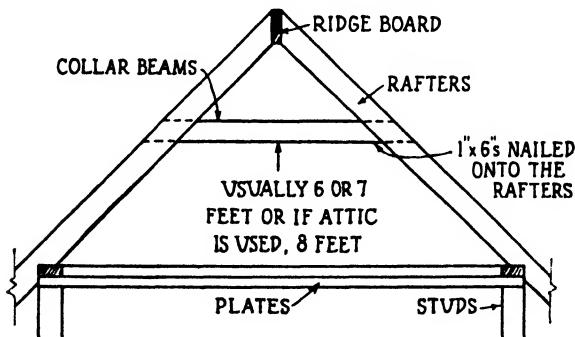


Fig. 64.—Collar beams are usually placed on every third rafter. They should be nailed on as the rafters are put in place. Care should be taken not to split the ends.

jacks use." Take the figure shown in the table on the body and 12 in. on the tongue. Mark along the tongue for the side cut.

Collar beams. Collar beams are pieces used as ties between rafters on opposite sides of the roof and designed primarily to stiffen it (Fig. 64). They should not be expected to hold the building together. They are usually placed well up on the rafters in order to leave head-room in the attic.

1. For light and medium roofs, use 1 by 6's.
2. For medium to medium heavy roofs, use 2 by 4's.
3. For heavy roofs, use 2 by 6's.

The length of a collar beam depends upon its position. Its most effective position is at mid-point. The length is usually taken from the blueprints. Collar beams are generally placed on every second or third rafter, as each pair of rafters is nailed in place. Care should be used in nailing on the collar beams so as not to split the ends.

3

ROOFING AND SIDING

Shingles. Shingles are pieces of roofing material varying in size, usually 12 to 18 in. long and 4 to 36 in. wide. They may be made of wood, asphalt, asphalt covered with crushed slate, asbestos, etc. Their purposes are definite:

1. They provide a weather-resisting surface for the top of a house.
2. They exclude water and moisture from a building.
3. They keep out the wind.
4. They keep out the dirt and dust.
5. They help keep the interior of a house warm.

WOOD SHINGLES usually come in two lengths, 16 or 18 in., and are generally laid 4 to 5 in. to the weather. They are tapered in thickness from $\frac{7}{16}$ in. at the butt to about $\frac{1}{16}$ in. at the top and are sold in bundles. If they are laid 5 in. to the weather, four bundles will cover about 100 sq. ft. or 1 square.

ASPHALT SHINGLES may be purchased individually or in strips. Individual shingles are usually 8 or 9 in. wide and 12 or $12\frac{1}{2}$ in. long. Strip shingles are usually three or four combined in one piece and come in widths from 10 to $12\frac{1}{2}$ in.; the length is usually 36 in.

These shingles are sold in bundles, usually laid $4\frac{1}{2}$ to 5 in. to the weather. Two or three bundles will cover a square, depending on

SPECIFICATIONS FOR ASPHALT SHINGLES

Size	Head lap, in.	Expose, in.	Weight per square, lb.	Shingles per square	Bundles per square
10" x 36"	2	4	210	100	2
12½" x 36"	4½	4	266	99	3
12" x 36"	2	5	257	80	3

The above specifications are typical of the size, weight, lap, exposure, and number of shingles and number of bundles in a square. These, of course, vary with different manufacturers. Follow the manufacturers' instructions for nailing on whenever possible.

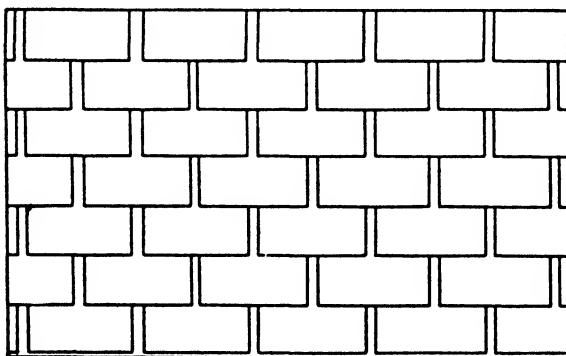


Fig. 65.—A pattern of composition shingles.

the thickness, weight, and number of strips. Good-quality strip shingles will weigh approximately 210 to 250 lb. (Fig. 65).

SLATE AND ASBESTOS SHINGLES vary in size and weight and should be laid only according to the manufacturer's directions.

How to space wood shingles. Wood shingles should not be used on a roof that has a *pitch of less than $\frac{1}{4}$* . Joints should not be closer together than $1\frac{1}{4}$ in. in any one course so that a hard rain cannot drive the water across into the joint below. Wood shingles should be laid about $\frac{1}{8}$ in. apart, no tighter.

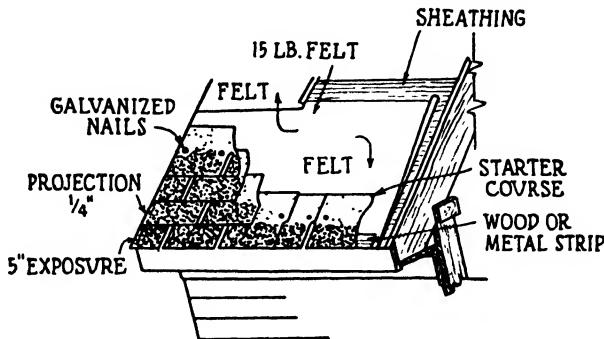


Fig. 66.—If a wood or metal strip is not used under the first course or starter course, another course of shingles may be used by nailing them on with slots up. This gives a double thickness at the eave. Always drive nails in directly over the slots.

Asphalt shingles are generally self-spacing, but an even distance for the weather or lap should be carefully maintained at all times.

How to nail on shingles. A double course of shingles should be used at the eaves to start the work. This is true for both wood and

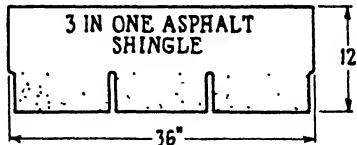


Fig. 67.

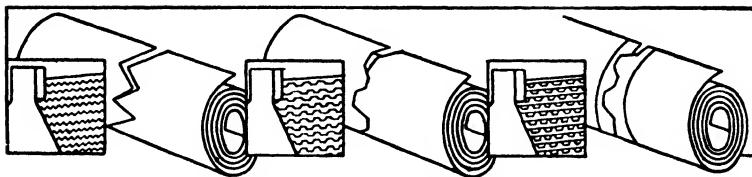
asphalt shingles. Wood shingles should be nailed on with hot-dipped galvanized, copper, or bronze nails, never with plain iron nails. Blunt nails are preferred because they are less liable to split the wood. Determine the amount of exposure to be used and lay the shingles to a chalk line (Fig. 66).

Asphalt shingles should be laid on a tight deck. For starting, lay a double row or course at the eaves, the first row with the slot up. Let these shingles project over the edge about $\frac{1}{4}$ in. Directly over this course lay another with the slots down. This gives a double thickness, and the $\frac{1}{4}$ -in. projection gives a drip edge. In nailing always drive the nails in just over the cutouts or slots up about $\frac{1}{2}$ in. Use large-head galvanized nails about 1 in. long unless circumstances require longer ones. Put five nails in each 4 in 1 shingle (four nails in 3 in 1 shingles) and always start at the center of the shingle. This prevents them from buckling. Ten-inch shingles should never be laid more than 4 in. to the weather; 12- and $12\frac{1}{2}$ -in. shingles, never more than 5 in. to the weather (Fig. 67).

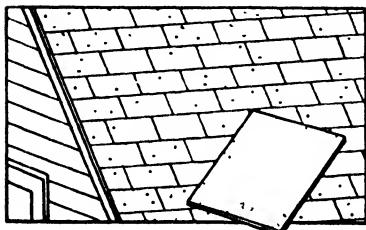
How to apply roll roofing. Roll roofing is material similar to asphalt roof shingles except that it is manufactured in rolls instead of in shingles. It comes in both a plain surface and a slate surface (Fig. 68).

Its purpose is the same as that of shingles. Practically any type of roll roofing commercially available will keep out water until the material begins to disintegrate. Its durability depends upon its thickness, proportions of ingredients, and conditions of service. Most rolls are made to cover 100 sq. ft., or 1 square. Weights vary from 50 to 125 lb. per roll or square. Widths vary from 12 to 36 in. Manufacturer's instructions should be carefully followed in regard to spacing and lapping. Never lap less than 2 in.

A great deal of care should be used in laying roll roofing. It is important that the roof be clean and dry. If not, the sheathing boards will shrink and cause the paper to buckle. All knotholes and other openings should have a covering of tin or sheet iron to prevent the paper from breaking through. In laying the roll or sheet, always work from the center out toward the ends. This allows the sheet to stretch before all of it has been nailed. It is a good plan to stagger the nails and thus prevent splitting of the sheathing boards. Lap the sheets according to the pitch of the roof. The steeper the roof, the less lap is needed. All laps should be secured with a smooth even joint of the cement that is usually supplied with the paper. Care

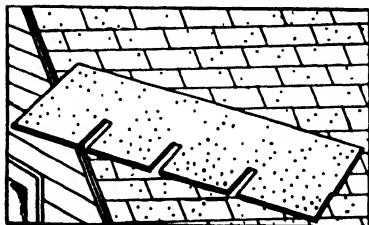
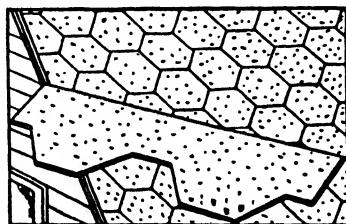


Imitation shingles made in rolls from roll roofing. These are applied in strips in the same manner as any other roll roofing.



Strip shingles come in various patterns. They are composed of two or more shingles combined into one piece.

Asphalt slate-surfaced shingles cut into individual shingles. These are nailed on in the same manner as any other shingle.



Strip shingles are usually notched or cut to look like individual shingles after they are nailed in place. They are notched at the factory at the time of manufacture.

Wood shingles may be used on the roof or on the side of the house. When used on the side of a house they are usually stained or painted.

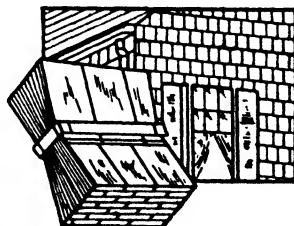


Fig. 68.—Types of roofing.

should be taken to flash around all openings, chimneys, etc. Flashings can be made by cutting pieces of the roll into squares about 8 by 12 in. square. Enough roof cement should be used to provide

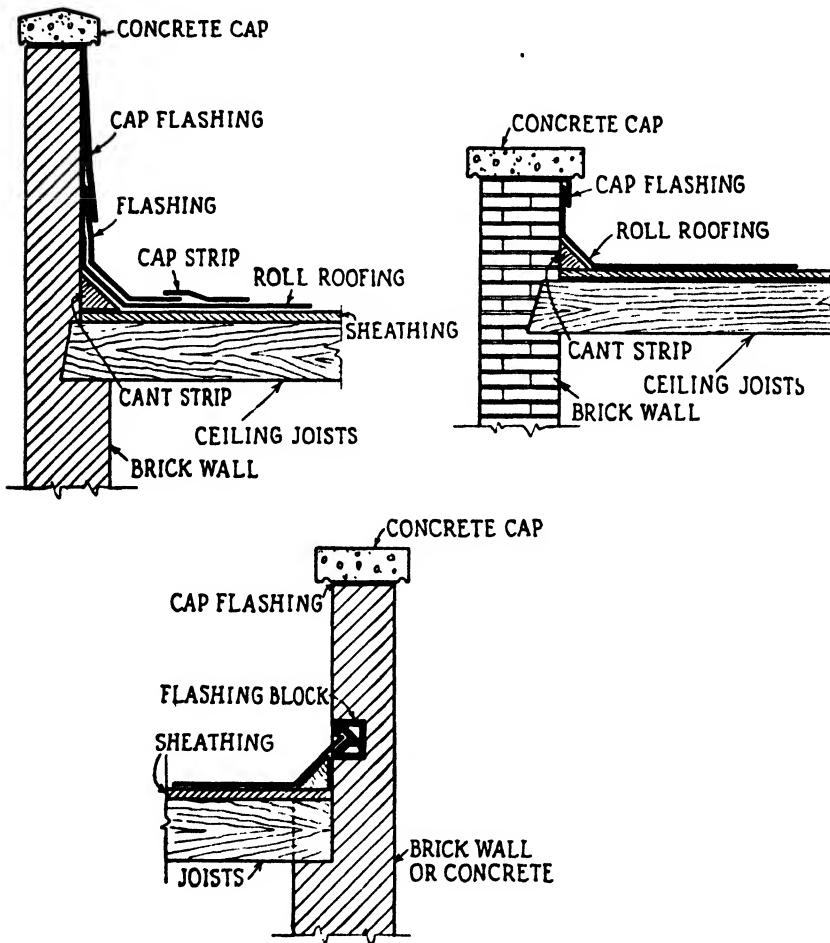
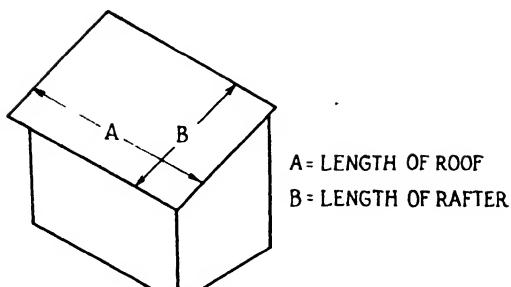


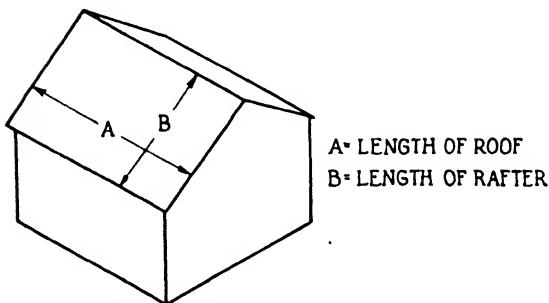
Fig. 69.

a good flashing job and to prevent water from seeping in back of the flashing (Fig. 69).

How to estimate roofing material. Most roofing material is sold by the square, which is equal to 100 sq. ft. It is necessary first to



LEAN TO OR SHED TYPE



GABLE TYPE ROOF

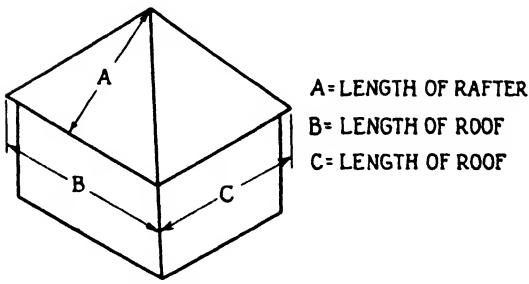


Fig. 70.

determine the number of square feet in the roof surface and then divide it by 100. This will give the number of squares needed. From 5 to 10 per cent should be added for trimming, cutting, and fitting, depending largely upon the type of roof being covered.

TYPE 1. For the lean-to, or shed type of roof (Fig. 70), multiply the length of the roof by the length of the rafters in feet. Divide by 100. This gives the needed number of squares. To this add 5 per cent for waste.

TYPE 2. The gable roof (Fig. 70) is figured the same as for the lean-to type, only there are two sides or surfaces instead of one. Add 5 per cent for waste.

TYPE 3. Hip and valley roofs (Fig. 70) are figured by multiplying the length of the roof or eave by the length of the rafter. Then divide this by 2. Measure and figure each side separately as they may be different in size. Add these surfaces together for the total number of square feet. Divide this by 100 for the number of squares needed. Add 10 per cent for waste.

Flashing. Flashing is usually made of copper, tin, lead, or asphalt roofing. It is roofing material that is used in places where ordinary shingling will not suffice (Figs. 71 to 73). These are usually around chimneys, in valleys, along gutters, under dormer windows, etc. The purpose is to make and complete a tight and waterproof roof at all joints, intersections, etc.

Sizes will vary according to use:

1. For main valleys, 16 to 20 in.
2. For dormer valleys, 8 to 10 in.
3. For porch and house connections, 8 in.
4. For roof and shed dormer, 10 in.

Along the edges of all valleys the shingles should be well bedded in roof putty. *This prevents water from washing across and under the shingles.*

How to flash around a chimney. All chimneys should be counter-flashed with tin, copper, zinc, or lead. The first step is to cut asphalt roll roofing into strips about 18 in. wide. Bend these to fit the sides

of the chimney, as shown in Fig. 72. Before nailing, embed these well in asbestos cement or roof putty.

The asphalt felt flashing is then step-flashed with metal shingles, or valley tin, which are bent so that they will extend under each

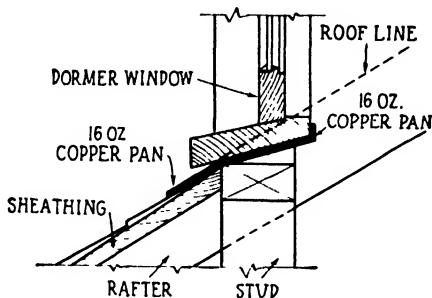


Fig. 71.—Installation of copper pan or flashing under dormer window.

course of roofing shingles on the lower end and also into the 1-in. deep cutout mortar joints in the chimney. Now wedge the metal flashing securely into the open joints in the brick and refill with cement or roof cement (Fig. 73). A cricket should be built on the high side of the chimney so that it will receive broadside the wash from the roof.

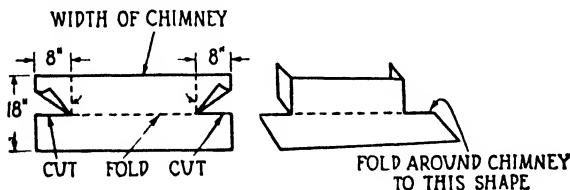


Fig. 72.

Flashing gutters. When relining gutters, use a good-weight valley tin or heavyweight slate-surfaced roofing paper. Nails should not be used in any part of the water course. Joints should be at least 9 in. with the run or slope of the gutter. If made of metal, they should be soldered; if of asphalt, they should be well embedded in roof cement.

How to apply wall shingles. Wall shingles are much the same as roof shingles. The chief difference is in the method of applica-

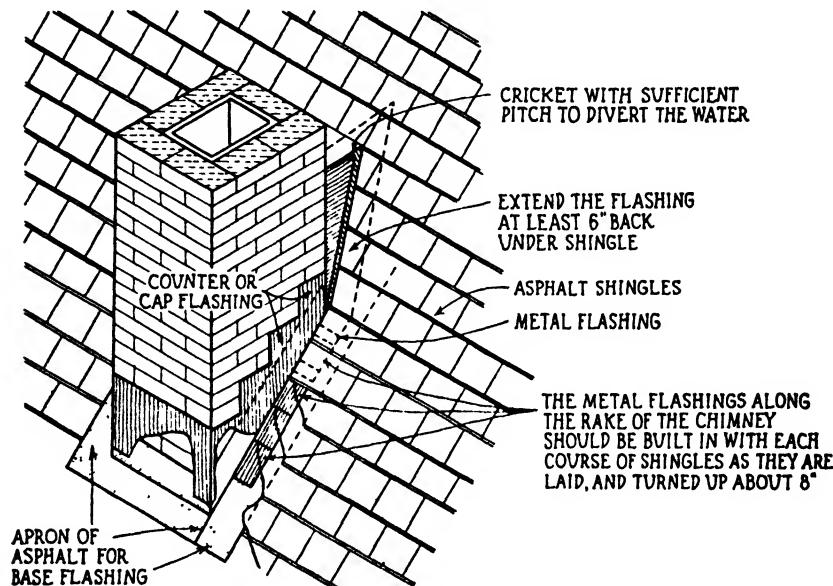


Fig. 73.—Installation of flashing around chimney.

tion. They may be wood, asbestos, asphalt, or other trade compositions. Their purpose is to provide an outside wall covering for the house; to prevent wind, air, and dust filtration; and to keep the heat in and the cold out. Sizes vary as shown in Table 6.

TABLE 6.—WALL SHINGLES

Kind	Size	To weather	Weight, lb., per square	Bundles per square
Wood.....	16"—18"—24"	7"—7½"—10"	108—117—144	3—3—3
Asbestos.....	12" x 24"	10" .	195—200	3
Asphalt.....	18" x 16"	7½"	110	2

WOOD SHINGLES should be spaced no less than $\frac{1}{4}$ in. apart. Two or more nails in each shingle should be used and put near the edge. Nails should be hot-dipped zinc or copper alloy. All shingle courses should be started at the foundation line with a double course. Courses should be laid out so that shadow lines will coincide with the upper and lower lines of the window openings. Corners of the

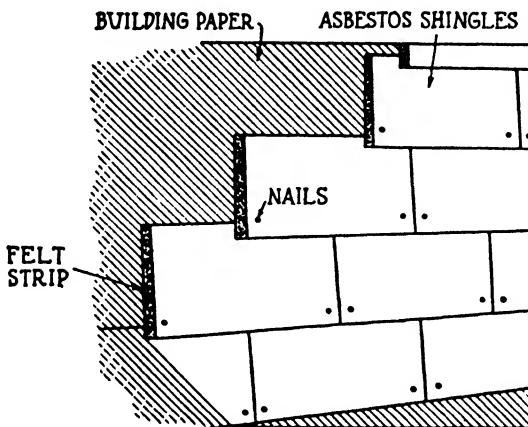


Fig. 74.—Asbestos shingles are nailed directly onto the side of the house. They are generally nailed on over building paper and laid to a chalk line. Joints are on halves.

building are laid out first, and then chalk lines or straightedges are used to nail the rest of the course on.

ASBESTOS WALL SHINGLES are nailed on in much the same manner as wood wall shingles, except that they do not lap over on the ends. Instead, they have felt strips at the end to seal the joints (Fig. 74). They are also secured with rustproof nails. The corners must be well fitted and lapped to make tight joints.

ASPHALT WALL SHINGLES should be spaced and applied in accordance with the manufacturer's directions.

Construction in general is the same for all side-wall shingles. Wood shingles may be purchased stained or unstained. Asbestos shingles are usually manufactured in colors, permanent and uni-

form throughout the shingle. Asphalt wall shingles, like asphalt roof shingles, come in various colors. The color is usually that of the slate applied to the surface.

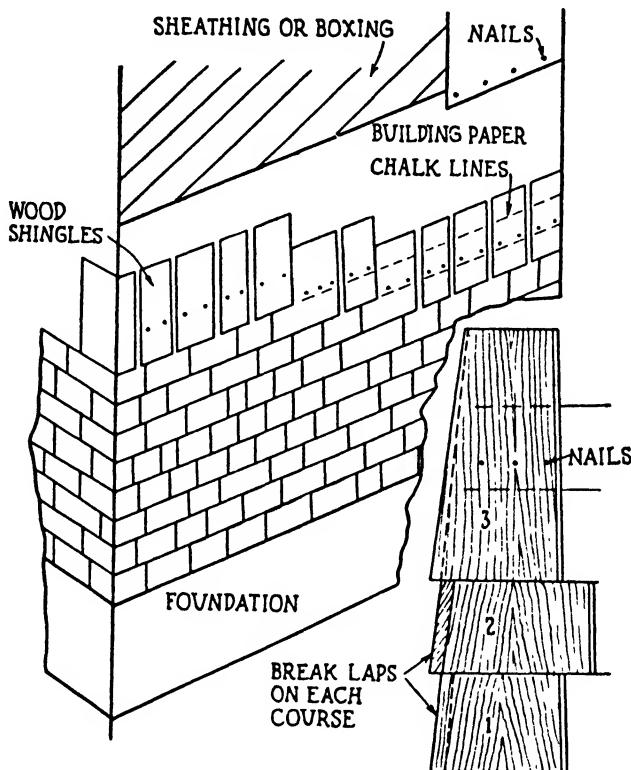


Fig. 75.—Build up the corners first, then draw a chalk line from the butt of each corner shingle. Lay on each course to a chalk line.

1. Start nailing on wall shingles by applying the first course at the bottom or foundation.
2. Let the first course be doubled and drop the butts down at least 1 in. below the foundation sill (Fig. 75).
3. Lay the shingles on to a chalk line or straightedge tacked on to the wall.
4. Break all joints back at least 1 to 2 in. or more for wood shingles.

5. Asbestos shingles should be broken on halfs, and a felt strip put under each joint.

How to apply wall siding. Wall siding or weatherboarding is the material or layer of special milled boards that forms the outside surface of a frame wall. There are two general kinds of siding: (1) bevel siding (Fig. 76) and (2) drop siding (Fig. 77).

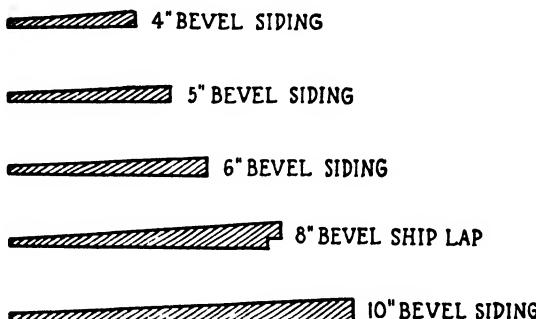


Fig. 76.—A few types of bevel siding.

The purpose is to keep out the wind and weather, to help keep a building warm on the inside, and to increase the strength of its construction. Bevel siding is available in 4-, 5-, 6-, 8-, 10-, 12-in. widths; drop siding in 4-, 6-, 8-, 10-, 12-in. widths.

The proper lap for bevel siding is as follows:

1. 4-in. siding, lap $\frac{3}{4}$ in.
2. 5-in siding, lap 1 in.
3. 6-in. siding, lap $1\frac{1}{2}$ in.
4. 8-, 10-, 12-in. siding, lap $1\frac{1}{2}$ in.

Siding may be applied directly over the studs, over solid wood sheathing, or directly over fiber, gypsum, and insulating boards.

1. Where sheathing is omitted, the stud walls should be well braced with let-in strips of 1 by 4 running diagonally from floor sill to top plate. For this type of construction drop siding is more suitable than bevel siding.

2. When siding is applied over wood sheathing, joints can be made anywhere. Siding should be nailed about every 16 in. with $6d$ finish nails, preferably rustproof and not set.

3. Substitute sheathing is usually made of gypsum, fiber board, or various kinds of insulating board. This requires the regular let-in

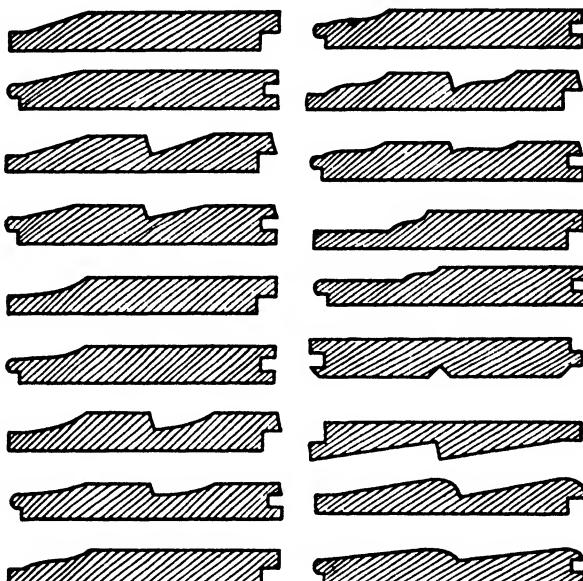


Fig. 77.—A few patterns of drop siding.

1 by 4 bracing to give added strength. Nails will not hold the siding to this sheathing unless driven into the studs. Use $10d$ finish rustproof nails and do not set them. Siding should be thoroughly dry before it is applied. The walls should be dry. Never apply siding soon after a rain storm. Let the sheathing and framework dry thoroughly. Otherwise, there will be shrinking, buckling, nails pulled loose, open joints, etc.

CORNERS. At the corner of a building, siding should be applied in one of the following constructions: (1) miter joints (Fig. 78), (2) butt against corner boards (Fig. 79), (3) metal-covered corners (Fig. 80).

Fig. 78.—Siding boards mitered at the corners.

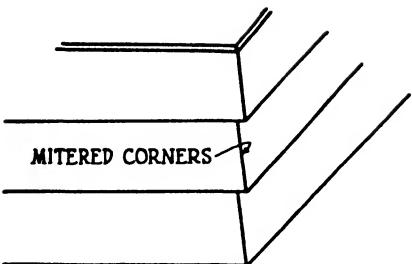


Fig. 79.—Siding cut and fitted to corner trim at the corner of the wall.

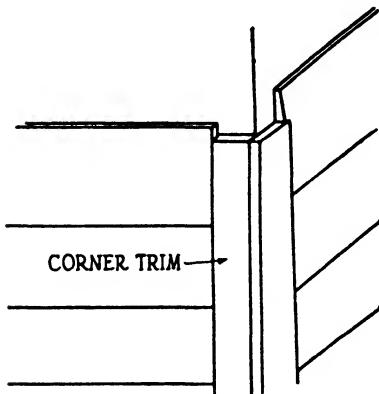
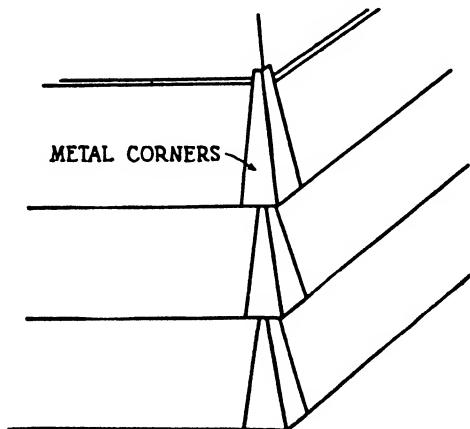


Fig. 80.—Metal corners are used to cover up the joints and to keep out moisture.



1. Miter joints are cut on the ends of the boards and fitted against each other at the corners.
2. Corner boards are 1- by 3- or 4-in. pieces nailed on the corner of the building vertically. Against these are butted the ends of the siding boards.
3. Metal corners are coverings made just the shape of the siding and are nailed on at the corner over the siding. They cover the joint, can be painted over, and remain unnoticed in the finish. They make waterproof corners and prevent them from opening up later.

Application should be started at the foundation, and courses should be laid out or "storied" so that shadow lines will coincide directly with the upper and lower lines of the windows. It is well to work to a chalk line and to see that each course is kept level.

Estimating siding. When estimating siding, count the solid surface and make no deductions for openings. Six-inch bevel siding should be exposed not to exceed $4\frac{1}{2}$ to $4\frac{3}{4}$ in.; and 4-in. siding from $2\frac{1}{4}$ to $2\frac{5}{8}$ in. to the weather. A $1\frac{1}{2}$ -in. lap is generally used on all beveled wood siding.

4

LATH AND PLASTER

Plaster grounds. Plaster grounds are strips of wood, dressed, usually about 1 by 2 in, and nailed directly to the framework at points where needed. They are the same thickness as the finish plaster, usually $1\frac{3}{16}$ in. Their purpose is to provide a guide for the plasterer and to avoid uneven plastering. In some cases the inside trim is nailed directly to the grounds; in others, as around doors, they are removed. Window frames often act as their own guide or grounds. Wherever finish wood trim comes in contact with plaster, some sort of grounds should be used.

BASE. Grounds should be installed all around the walls at the floor (Fig. 81). Sometimes one and sometimes two are used. This ensures a smooth surface on which to nail the baseboard and base mold. It also provides a solid surface on which to nail.

DOORS. Grounds should be installed at all doors, inside or outside, where finish or trim is to be used. This ensures a snug fit and a smooth solid surface to which may be nailed the trim. In cheap work where it is customary to use the doorjamb itself for a ground, the jamb must be set before plastering. This usually results in the following objectionable situations:

1. The corners of the jambs become rough.
2. A clean sharp corner is impossible.
3. Wood becomes scratched.
4. Frame becomes injured by tools, lumber, etc.
5. Frame gets wet and swells, grain raises, etc.

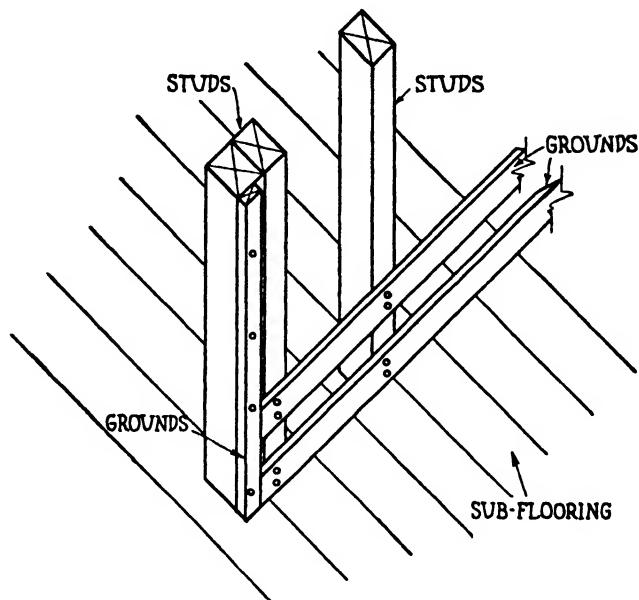


Fig. 81.—Grounds should be installed all around the walls at the floor. They are 1 by 2's, $\frac{3}{4}$ in. thick. They ensure a smooth edge to plaster to and a firm base on which to nail the finish trim.

It is much better to apply temporary grounds for the doors and tack them in place securely. Most carpenters make a guide for this work. It is a frame made the exact width of the wall after the plaster has been put on. This is set square and plumb, and the grounds are aligned to it. Most frame walls finish to $5\frac{1}{4}$ in. thick. A common practice is to use wood laths for door grounds, but 1- by 2-in. strips are much better.

Window grounds. Double-hung frame windows usually provide a ground in themselves. Casement frames are largely the same as

door frames in that the grounds may be set first or the frame may be used. For all masonry walls and special construction, the problem of grounds must be worked out wherever wood trim is to be used.

Miscellaneous grounds. All such work as chair rails, dadoes, wainscoating, panels, picture molds, and mantels should have grounds, the size, of course, depending upon the work.

How to mark studs. It is always necessary to mark the location of all studs on the subfloor with a heavy crayon or by driving a large-head shingle nail into the floor before the plaster is put on. This aids in nailing on the base and mold later when the studs are covered.

How to apply wood lath. Lath, regardless of its kind, is a base for plaster. It is nailed directly to the studs. Its purpose is to strengthen the wall and to provide a surface for the plaster.

Wood laths are usually $\frac{3}{8}$ in. thick, $1\frac{3}{8}$ in. wide, and 32 or 48 in. long. They are generally sold by the 1,000 and weigh about 335 lb. for the 32 in. and about 500 lb. for the 48 in. per thousand. Wood lath other than No. 1 should not be used.

In nailing laths, space them about $\frac{3}{8}$ in. apart in order to allow the plaster to be squeezed through the cracks and form keys on the back. This holds the plaster on. Laths should be nailed to and over all studs. Threepenny wire lath nails are used for this.

Nail on 7 rows of laths and then break over one space of studs and nail on 7 more (Fig. 82). Never run laths over or behind a partition. With the use of a low scaffold, nail laths on the ceilings first, then on the side walls.

MATERIAL. Laths should be of good quality, No. 1 as stated above. White pine or cypress laths are preferable when they can be obtained. They should not have back or sap edges.

WETTING. It is very important that *wood* laths be wet or dampened before plastering. This prevents cracks later from swelling, warping, twisting, and buckling. If possible, wet them down a day before plastering begins.

How to apply metal lath. Metal lath is made from sheet metal perforated for use as a plaster lath, instead of wood lath. Metal lath

comes in sheets, usually 27 by 96 in., either painted or galvanized. Standard weights are from 2.2 to 3.4 lb. per sq. yd. (Fig. 83).

Metal laths are nailed directly to the studs with a sufficient lap. Some of them are backed with high-grade building paper. A large mesh should never be used for wall plastering, because it will cause

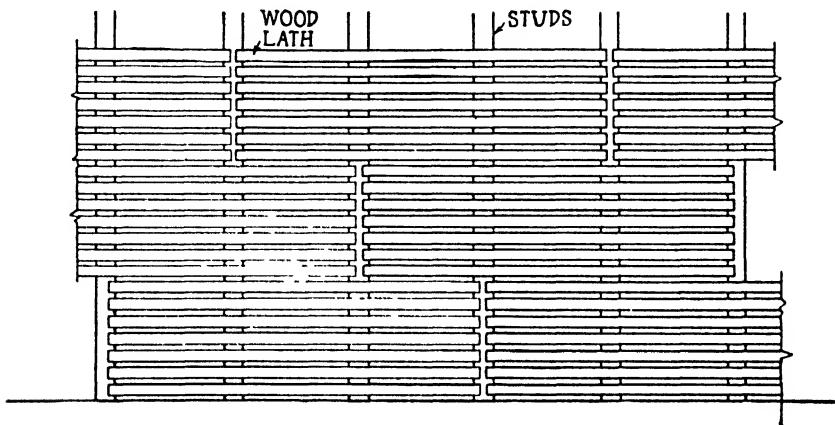


Fig. 82.—Method of spacing wood laths on studs. Nail on seven laths and then break over one space of studs and nail on seven more. Nail on the ceilings first, then nail on the side walls.

cracks. A good stiff lath should be used. All sheets should be well lapped and nailed. The minimum weights for metal lath should be as follows:

1. For wood studs: 2.2 lb. per sq. yd.
2. For ceilings on wood joists: 2.75 lb. per sq. yd.
3. For steel studding: 2.5 lb. per sq. yd.
4. For suspended ceilings: 3 lb. per sq. yd.

How to put on gypsum lath. Gypsum lath, or rock lath, is a plasterboard base applied directly to the studs and joists. Its purpose is the same as that of metal lath or wood lath. Its sizes vary, the most popular working sizes being $\frac{3}{8}$ in. thick, 16 in. wide, and 32 or 48 in. long. All joints should be staggered (Fig. 84).

Gypsum lath should not be wetted. It is generally perforated; that is, small holes about the size of a nickel are distributed evenly over the entire surface. Through these the plaster is squeezed and formed into keys on the back. This helps hold the plaster on.

1. Prepare a scaffold built on sawhorses or other means, just high enough for you to stand upon and reach the ceiling. Use 2 by 10 walk boards.

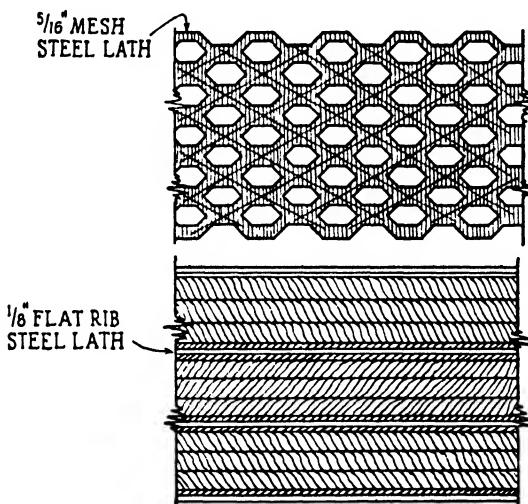


Fig. 83.

2. Cut the gypsum lath with an old saw.
3. Use up all scraps and pieces whenever possible, instead of cutting more whole pieces.
4. Drive four large-head lath nails through the lath into each stud or ceiling joist.
5. Nail on the ceilings first. Stagger all joints or, in other words, do not let any two ends break together on the same stud.
6. After the ceiling has been put on, start *down* the sides, working from the ceiling down.
7. If wall insulation is to be used, see that it goes in between the studs and below the window sill before the lath is applied.

8. Cut out and fit carefully around all electric receptacles, outlets, openings, etc.

9. If doorjambs have been set, fit the lath up neatly to the jamb. Do the same around all window frames.

Wallboard. There is also on the market a great variety of gypsum wallboards, in sheets $\frac{1}{4}$, $\frac{3}{8}$, or $\frac{1}{2}$ in. thick, 36 and 48 in. wide,

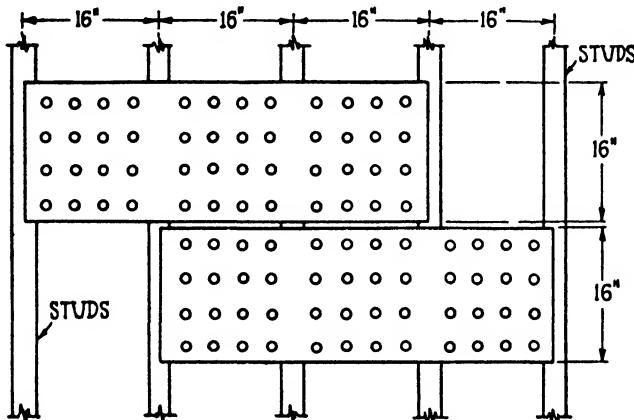


Fig. 84.—How to apply rock lath.

and from 4 to 12 ft. long. Apply them in the same manner as gypsum lath, or rock lath.

1. Use regular wallboard nails.
2. Always put ceilings on first.
3. Use sheets as long as the walls are high.

How to apply corner bead and corner lath. Corner bead (Fig. 85) is used on vertical and horizontal corners and edges in rooms over wood and gypsum lath. It provides a definite edge to which to finish the plaster. It also serves as a protection to a corner that has been plastered and helps to form more accurately the shape of arched doors, openings, etc. It usually comes in stock lengths 6, 7, 8, 9, 10, or 12 ft. long. It is made mostly in 26 gauge and weighs about 200 lb. per thousand feet. It is nailed on the corners with lath nails over the laths.

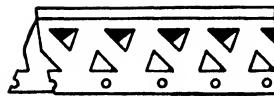


Fig. 85.—Corner bead provides a definite edge against which to finish the plaster. It also helps to form more accurately the shape of doors and other openings.

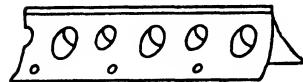


Fig. 86.—Corner lath is nailed in all the inside angles of the room.

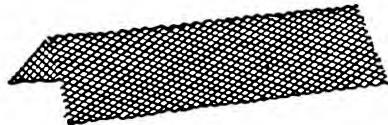
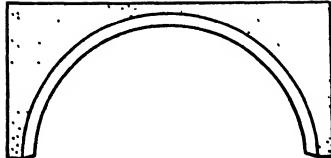


Fig. 87.—Metal door arches are used a great deal in plastered openings.



Corner lath is nailed in all the inside angles of a room. It is cut in strips about 4 in. wide and bent to a right angle (Fig. 86). Its purpose is to prevent cracks in the plaster at the angles.

Metal door arches are used a great deal now in plastered openings, because they are installed very quickly and present a much neater finished job than do the ones built up from wood and covered with corner bead (Fig. 87).

1. Nail all corner bead, corner lath, or metal arches on after the other lath has been applied. Nail them on over the other lath.
2. Use regular lath nails.
3. Cut all bead, corner lath, etc., with tin snips.

5

FINISH—TRIM, WINDOWS, AND DOORS

INSIDE FINISH

Inside finish or trim is that part of the construction usually consisting of the following:

1. Doorjambs
 - a. Sides
 - b. Head
2. Door trim
 - a. Side casings
 - b. Head casings
 - c. Stops
 - d. Back bands (not always used)
3. Window trim
 - a. Side casings
 - b. Head casings
 - c. Stool
 - d. Apron
 - e. Stops
 - f. Mullions (for more than one window)

4. Baseboard

- a.* Baseboard
- b.* Base molds
- c.* Base shoe

5. Doors

- a.* Inside
- b.* Outside

6. Built-in cabinets

- a.* Kitchen cabinets
- b.* China cases
- c.* Bookcases
- d.* Linen cases
- e.* Storage cases
- f.* Ironing board

7. Floors

- a.* Hardwood
- b.* Softwood

8. Miscellaneous

- a.* Clothes chute
- b.* Telephone
- c.* Mailbox
- d.* Built-in recesses
- e.* Fireplace mantels
- f.* Breakfast nooks, seats, etc.

Doorjambs. Doorjambs are the linings or the sides of the openings (Fig. 88) that form doorways. Their purpose is to provide a finished surface for that part of the doorway. To the jambs are nailed the casings and stop; on them are hung the doors.

Doorjambs are made of stock usually $\frac{3}{4}$ in. thick for inside jambs and $1\frac{3}{8}$ in. thick for outside jambs. The width, usually $5\frac{1}{4}$ in., may vary slightly, since the jambs should be just as wide as the plastered walls are thick. Inside jambs are usually built up with a stop $\frac{3}{8}$ by $1\frac{3}{8}$ in. nailed to the jamb to shut the door

against. Outside jambs are usually rabbeted out to receive the door.

Rough openings for doorjambs are usually made in frame walls $2\frac{1}{2}$ in. larger each way than the size of the door to be hung. This allowance is for *plumbing* and *leveling* of the jambs.

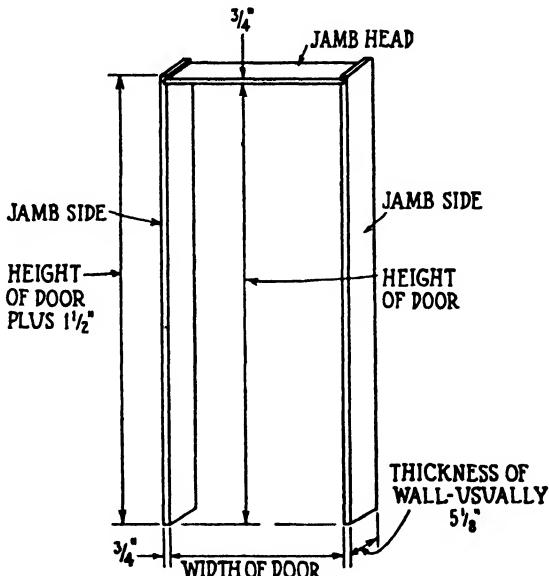


Fig. 88.—Doorjambs are linings, or the sides of the openings that form the doorways. Their purpose is to provide a finished surface for that part of the doorway. On the jambs are nailed the casings and the stop. The doors are also hung on the jamb.

How to make and set a doorjamb

1. Regardless of how carefully rough openings are made, it is always necessary to plumb the jambs and level the heads, when jambs are set.
2. Rough openings are usually made $2\frac{1}{2}$ in. bigger each way than the size of the door to be hung. For example, a 2 ft. 8 in. by 6 ft. 8 in. door would need a rough opening of 2 ft. $10\frac{1}{2}$ in. by 6 ft. $10\frac{1}{2}$ in. This extra space allows for the jambs, the wedging, and the clearance space for the door to swing (Fig. 89).

3. Level the floor across the opening to determine any variation in floor heights at the point where the jambs rest on the floor.

4. Now cut the head jamb with both ends square, having allowed the width of the door plus the depth of both dadoes and a full $\frac{3}{16}$ in. for door clearance.

5. From the lower edge of the dado, measure a distance equal to the height of the door plus the clearance wanted under it. Mark and cut square.

6. On the opposite jamb do the same, only make additions or subtractions for the variation in floor, if any.

7. Now the jambs and jamb heads are nailed together with $8d$ common nails through the dado into the head jamb.

8. Set the jambs into the opening and place small blocks under each jamb on the subfloor just as thick as the finish floor will be. This is to allow the finish floor to go under.

9. Plumb the jambs and level the jamb head.

10. Wedge the sides with shingles between the jambs and the studs, to align, and then nail securely in place.

11. Take care not to wedge the jamb unevenly.

12. A long straight edge 5 or 6 ft. long is used inside the jambs to help prevent uneven wedging.

13. Check jambs and head carefully, as jambs placed out of plumb will have a tendency to swing the door open or shut, depending on the direction in which the jamb is out of plumb.

Door trim. Door trim is material nailed onto the jambs and plaster around the door to provide a finish. It is frequently called "casing" (Fig. 90). Its purpose is to provide a finish between the jambs and the plastered wall. Sizes vary from $\frac{1}{2}$ to $\frac{3}{4}$ in. in thickness, and from $2\frac{5}{8}$ up to 5 and 6 in. in width. Narrow trim has become very popular in the past few years. Size is a matter of personal taste.

Most trim has a concave back to fit over uneven plaster. In mitered work, care must be taken to make all joints clean, square, and neat.

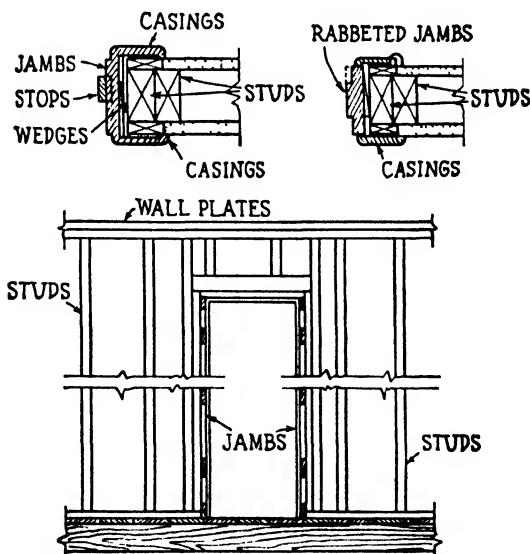
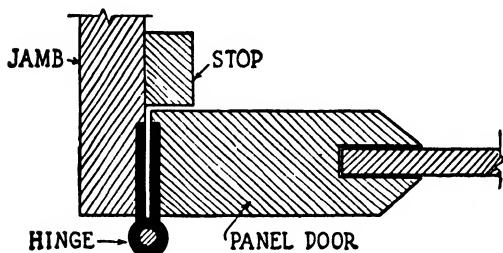
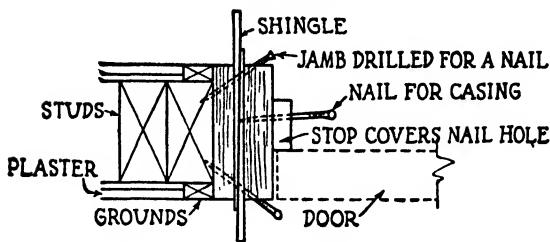


Fig. 89.

In nailing, take special care not to touch the wood with the head of the hammer. Nails should be driven home with a nail set.

Window trim and casing. Window trim is the material or pieces nailed onto the frame and plaster around a window. It usually con-

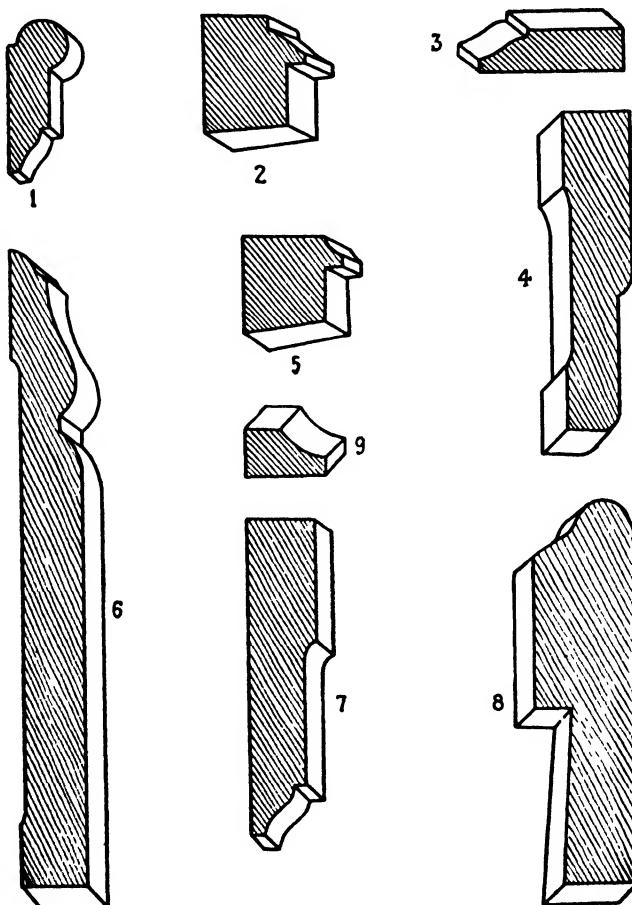


Fig. 90.—1. Picture mold, 2. cap mold, 3. window stop, 4. window and door casing, 5. chair rail cap, 6. baseboard, 7. chair rail, 8. window stool, 9. base shoe.

sists of the same casing as the door casing, the stops, window stool, and apron (Fig. 91).

1. Cut and fit the stool into and around the window jambs. Nail in place onto the subsill.

2. Cut the casings off square on the ends and stand up in place and mark to right length. Cut and nail into place.
3. If a mullion is used, fit and nail it into place.
4. Cut and fit the head casing and nail it into place.

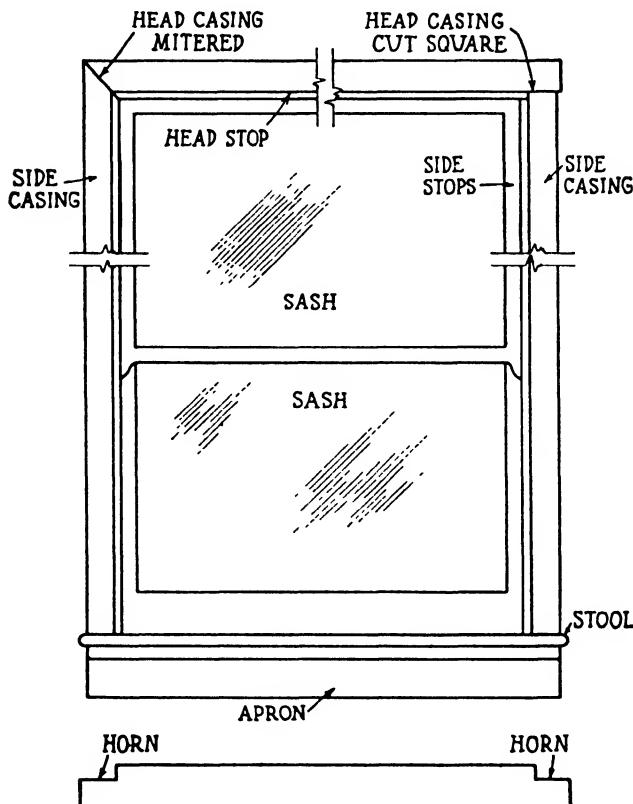


Fig. 91.—Plan of stool.

5. Cut the apron to correct length and nail it into place under the stool.
6. Set all nails with a nail set slightly below the surface of the wood.

How to nail down baseboard. Baseboard is the piece nailed to the wall all around a room at the floor line (Fig. 90). Its purpose is to provide a finish at the junction of the floor and the wall. It

protects the wall from bumps, scratches, water, floor cleaning, etc. Baseboard generally has a piece called "base mold" nailed on top and a piece at the bottom nailed to the floor, called "base shoe."

Baseboard is generally from $\frac{5}{8}$ to $\frac{3}{4}$ in. thick, and from 4 to 10 in. wide. Wider than 10 in. or narrower than 4 in. is not recommended. Baseboard wider than 10 in. is difficult to construct and is likely to warp and open at the joints. Baseboard narrower than 4 in. is not apt to give sufficient protection to the wall.

1. Cuts should occur only at corners, intersections, doors, etc.
2. Interior corner cuts should be scribed and butt-jointed.
3. Exterior corner cuts should be mitered and nailed to each other.
4. The baseboard, otherwise, should be nailed to the studs.
5. Nail with $8d$ case nails, set, and fill.
6. In starting to nail, place blocks 1 in. thick under the base. This is to allow for the finish floor to go under the baseboard.
7. As soon as one piece of baseboard is nailed on, move the blocks to the next one.
8. All trim except the base shoe is put in place before the finish floor is laid.
9. The base shoe is nailed down after the floor has been laid.

Base mold. Base mold is a piece of molding nailed to the top edge of the baseboard. Its purpose is to conceal irregularities in the plastered wall and give a finished edge to the baseboard and plaster. Some baseboards do not require this, as they have a molded edge on top. However, this type does not give so good a fit as the base mold does.

Base molds vary with the thickness of the baseboard. For $1\frac{3}{16}$ -in. baseboard the mold should not be more than $\frac{5}{8}$ in. thick. The width of mold is a matter of choice.

Cuts in mold should be made at the corners, at doors, or at places not readily noticeable. There are two methods of making cuts or joints at the interior corners: (1) mitering (Fig. 92), (2) coping (Fig. 92).

Coped joints are considered the better because, if they open up, the crack is not noticeable. For exterior corners mitering is, of course, used.

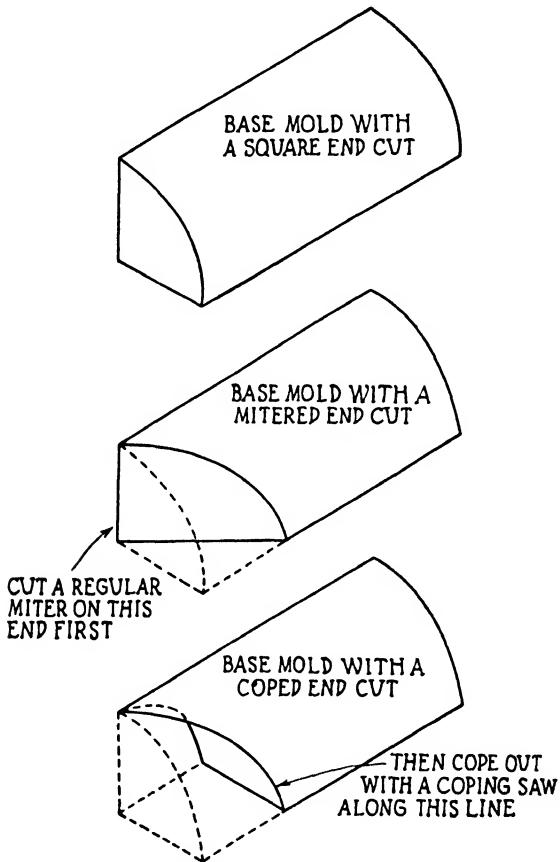


Fig. 92.

Nails should be used long enough to go through the mold, the plaster, and into the studs. It is usually necessary to drill holes for these nails as they are liable to split the molding.

Base shoe. Base shoe is molding nailed at the intersection of the baseboard and the *finished* floor. Its purpose is to cover or conceal the crack there (Fig. 93). Sizes vary but are usually about $\frac{3}{4}$ by $\frac{3}{4}$ in. or $\frac{5}{8}$ by $\frac{5}{8}$ in.

Construction is the same as for base mold. Use nails that are long enough to reach into the subfloor. This prevents the shrinking of the baseboard from pulling the shoe up from the floor (Fig. 93).

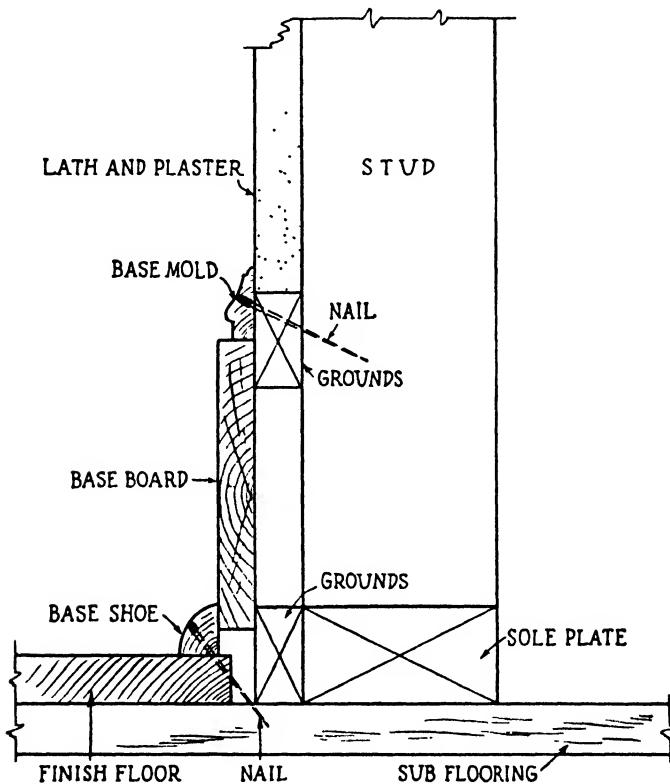


Fig. 93.—Installation of base shoe, base mold, and base board.

Finish floor. The finish floor is that which serves as the last or final floor to be laid and becomes the actual wearing surface. It may be laid over the subfloor but is sometimes laid directly onto the joists where no subfloor is used. The purpose is to provide a surface for floor wear.

Even in small house construction there are many types of floors, such as hardwood, softwood, wood blocks, etc., all with different textures, grades, thicknesses, widths, and lengths. Of these, the fol-

lowing have been selected as the best for the small house or average home:

1. Yellow pine
2. Oak (white and red)
3. Maple
4. Birch

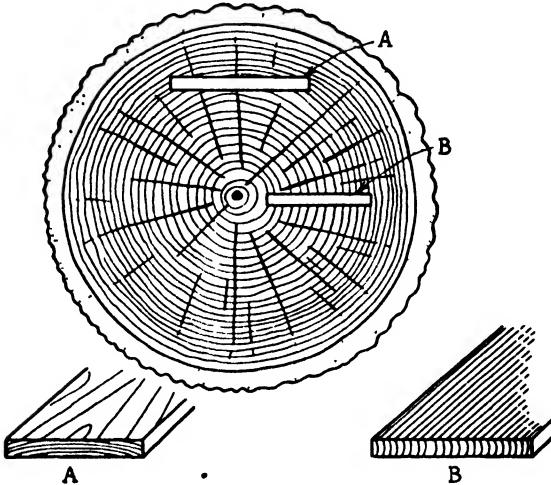


Fig. 94.—Wood flooring is classified according to the method used in sawing it. When sawed from the logs as shown at A, it is classified as flat grain, or flat sawed. When sawed as at B, it is classified as quartersawed, or edge grain. Edge-grain wears much better than flat-grain and does not shrink as much.

Wood flooring is classified according to the method of sawing. It may be

1. Quartersawed (edge grain) (Fig. 94)
2. Plain sawed (or slash sawed) (Fig. 94)

As a rule, maple and birch are not sold as quartersawed. *Edge-grain* flooring gives much the most wear. It is cut so that the edge of the grain is presented as a wearing surface. It does not splinter and is hard and extremely durable. *Plain-sawed* or flat-grain flooring may be cut from the same log, but because of the direction of the grain it will be less durable.

Most *softwood* flooring is graded as follows:

1. "A" and "B and better," stain, varnish, wax, or natural.
2. "C" and "D," stained dark or painted.
3. No. 1 and No. 2, for subfloors and rough or hard usage. "A" and "B and better" are generally used for finish floor work.

Standard sizes for softwood flooring are $2\frac{5}{32}$, $1\frac{1}{16}$, or $1\frac{5}{16}$ in. thick, and $1\frac{1}{2}$, $2\frac{3}{8}$, $3\frac{1}{4}$, $4\frac{1}{4}$, or $5\frac{3}{16}$ in. wide. Lengths run from 8 to 16 ft. The average small-house owner usually selects $2\frac{5}{32}$ by $2\frac{3}{8}$ in., with edge grain.

Most *hardwood* flooring is graded as follows:

1. Clear grade
2. Select grade
3. No. 1 common
4. No. 1 common and better shorts
5. No. 2 common

Standard sizes for oak flooring are $\frac{3}{8}$ by $1\frac{1}{2}$ in., $\frac{3}{8}$ by 2 in., $\frac{1}{2}$ by $1\frac{1}{2}$ in., $\frac{1}{2}$ by 2 in., $1\frac{3}{16}$ by $1\frac{1}{2}$ in., $1\frac{3}{16}$ by 2 in., $1\frac{3}{16}$ by $2\frac{1}{4}$ in. Oak is generally considered the best hardwood for flooring, $1\frac{3}{16}$ by $2\frac{1}{4}$ in. being the most desirable size.

How to estimate flooring. For estimating the amount of flooring needed:

1. Find the number of square feet of actual floor area.
2. To this add the proper percentage given in Table 7.

How to lay hardwood floors

1. Do not lay the finish floor until all other finish work is done.
2. Do not lay the finish floor until all plastering is done.
3. The building must be perfectly dry.
4. Before starting to lay the finish floor, clean the subfloor and cover it with a layer of heavy waterproof building paper or deadening felt.
5. Start at one side of the room and lay flooring lengthwise with the room so that it will pass through any doors without a break.

6. Lay the first strips with the groove side to the wall and even with the plaster finish. Always use case nails of sizes indicated in Table 7.

TABLE 7.—FLOORING DATA

<i>Kind</i>	<i>Thickness, in.</i>	<i>Width, in.</i>	<i>Per cent added</i>	<i>Size of case nails</i>
Oak	$1\frac{3}{16}$	$1\frac{1}{2}$	50	<i>8d</i>
	$1\frac{3}{16}$	2	$37\frac{1}{2}$	<i>8d</i>
	$1\frac{3}{16}$	$2\frac{1}{4}$	$33\frac{1}{3}$	<i>8d</i>
	$1\frac{3}{16}$	$2\frac{1}{2}$	$33\frac{1}{3}$	<i>8d</i>
	$\frac{3}{8}$	$1\frac{1}{2}$	$33\frac{1}{3}$	<i>4d</i>
	$\frac{3}{8}$	2	25	<i>4d</i>
	$\frac{1}{2}$	$1\frac{1}{2}$	$33\frac{1}{3}$	<i>6d</i>
	$\frac{1}{2}$	2	25	<i>6d</i>
Maple	$2\frac{5}{32}$	$1\frac{1}{2}$	50	<i>8d</i>
	$2\frac{5}{32}$	2	$37\frac{1}{2}$	<i>8d</i>
	$2\frac{5}{32}$	$2\frac{1}{4}$	$33\frac{1}{3}$	<i>8d</i>
Pine	$2\frac{5}{32}$	$2\frac{3}{8}$	27	<i>8d</i>
	$2\frac{5}{32}$	$3\frac{1}{4}$	23	<i>8d</i>
	$2\frac{5}{32}$	$5\frac{3}{16}$	15	<i>8d</i>

7. In nailing take care that joints are not closer than 12 in. and that none comes directly across from another.

8. Toenail the strips in place, but do not damage the edges of the flooring. Nails should be placed *not farther apart than 10 in.* and set.

9. Stubborn pieces of flooring may be driven home with a block.

10. After the floor is laid, put down base shoe all around the room.

11. Scrape and sand the floor in preparation for finishing.

Stairs and steps. Stairs can be defined as a series of steps ascending or descending from one floor or level to another. Their purpose is to provide an easy method or means of ascending or descending from one floor to another, the most common method in a small-house construction. *Stairs* are usually classified as "open" or "closed" and generally lead from one floor to another. *Steps* may be open or closed and are generally used where very short rises occur, usually at front porches, back porches, landings, terraces, etc.

Stair treads. Stair treads and risers vary in size (Fig. 95), determined entirely by the rise and run allowed for the stairs or steps. Where space permits, treads should be 10 to 12 in. wide; risers, 7 to 8 in. high.

How to determine the rise and the run. In constructing any stairs or steps, first determine the amount of rise and the amount of run (Fig. 96). The *rise* of a flight of stairs is the perpendicular distance to which the stairs will rise, or the actual distance between two floors or levels in a building (Fig. 96). It is the total sum of all the widths of all the risers.

The *run* of a flight of stairs is the distance measured on a level from the foot of the stairs to a point directly under the upper end or point of landing (Fig. 96).

The *nosing* on a tread is the projection over the front edge, usually about the thickness of the treads.

The *stringer* is the finish board at the end of the treads against the wall. It forms a protection for the plaster. Stringers or horses are also used under the treads and risers for support (Fig. 97). There is always *one* more riser than treads.

How to find the number of treads and risers. First decide on the height of riser desired. Then divide the rise by this figure. This will give the number of risers.

Example. Rise equals 98 in. and the height of riser desired is 7 in.

Solution. $98 \div 7 = 14$, or 14 risers.

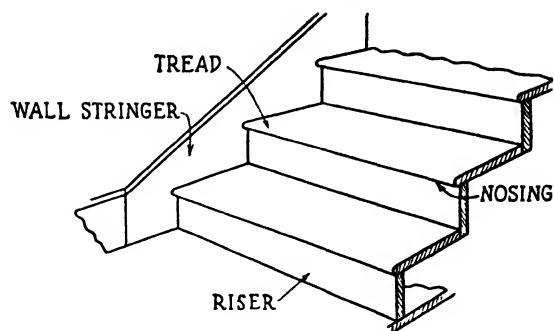


Fig. 95.

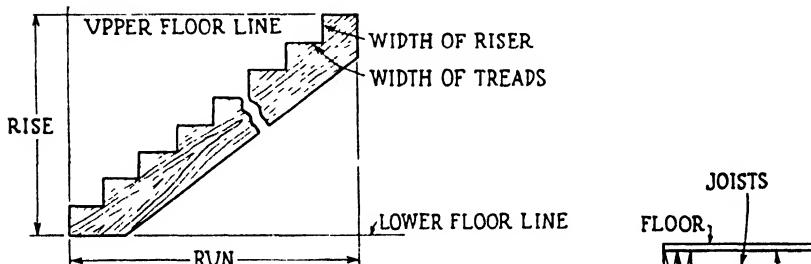


Fig. 96.

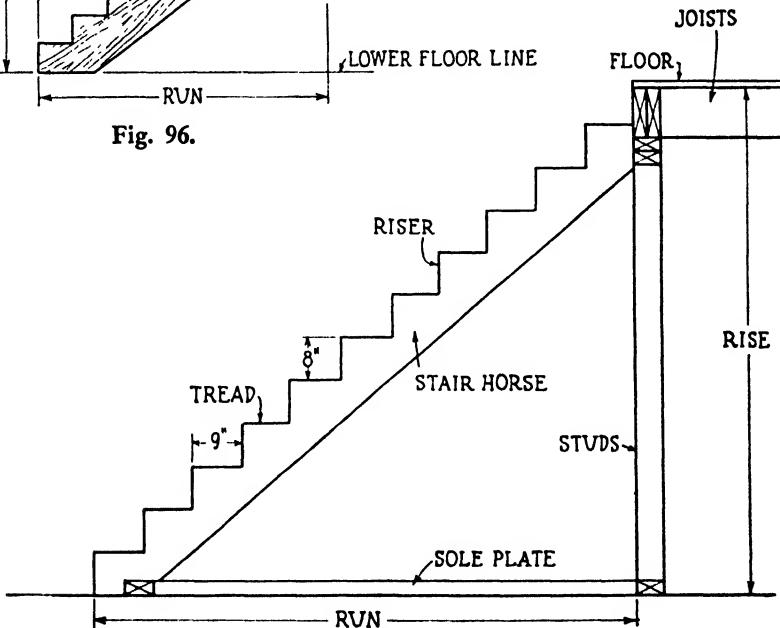


Fig. 97.

As there is always one more riser than treads, the number of treads will be 13. Divide the run by 13, and you will have the width of the treads. To this add for projection and nosing.

Example. The run is 10 ft. 10 in., or 130 in.

Solution. $130 \div 13 = 10$, or 10 in., the width of the tread, without nosing. To this add for projection and nosing.

CUTS. The cuts, therefore, for stringers or horses will be 7 and 10 on the square. Hold the square on the edge of the stringer at the 7 and 10 in. marks, and mark along each side of the tongue and blade.

OUTSIDE FINISH

Outside finish is the term applied to those parts of the outside of the house that generally go to make up the trim. It includes:

1. Frieze boards
2. Fascia boards
3. Plancier boards
4. Molds
5. Corner boards
6. Shutters
7. Wood steps
8. Wood posts
9. Window casings
10. Door casings
11. Garage doors
12. Window boxes
13. Screens, etc.

Outside trim is generally classified as all other than the main wall coverings. All outside trim is usually white pine clear, or cypress clear, and should be painted or primed when set and nailed in place.

Roof cornices. A cornice is that part of house construction where the roof and side walls intersect (Fig. 98). Its purpose is to provide

a definite and satisfactory finish at this point. The size is determined largely by the size of the house and the type of architecture.

Types of cornice. It would be difficult to explain all the different types of cornice here, but in general, the main construction lies in

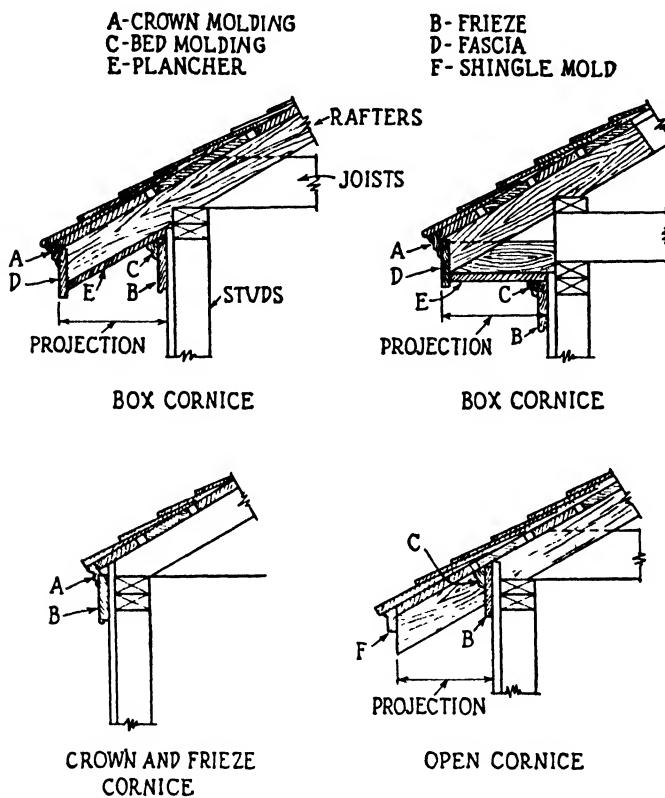


Fig. 98.

concealing the ends of the rafters and at the same time providing a pleasing finish around the roof at its intersection with the side walls.

CROWN AND FRIEZE CORNICE, used on

- a.* Cape Cod style
- b.* Colonial style
- c.* Adaptations
- d.* Inexpensive construction

OPEN CORNICE, used on

- a.* Bungalows
- b.* Summer cottages
- c.* Sleeping porches
- d.* Garages
- e.* Rustic construction

BOX CORNICE, used on

- a.* Colonial types
- b.* Early American types
- c.* Modern types

The frieze, fascia, plancier board, crown mold, bed mold, and shingle mold are usually white pine or cypress and should be primed as soon as they are nailed or set in place.

Dormer windows. A dormer window is a window framed out from the roof (Fig. 99). The purpose is to enable attic space to be transformed into regular room space by admitting light. Sometimes these windows are above the eave line and sometimes below. Sizes vary according to the size of the house and the kind of architecture employed. Dormers may be classified as follows:

1. Flat-top dormers
2. Gable dormers
3. Hip dormers

Dormers are framed in when the roof is framed. Much care should be taken to prevent leaks at the intersection of dormer walls and the roof. Dormers should be well flashed and counterflashed. It is common practice to frame in dormers with 2 by 4's even if the rafters are much heavier. Window-sash size and construction detail are usually provided by the architect.

Windows and window frames. Window frames are set into the frame wall to receive the window sash. Their purpose is to hold the sash. Sizes are determined by the size of sash. Frames in sizes to fit all types of sash may be obtained in the following forms:

1. Knocked down
2. Assembled from local planing mills
3. Constructed by carpenter

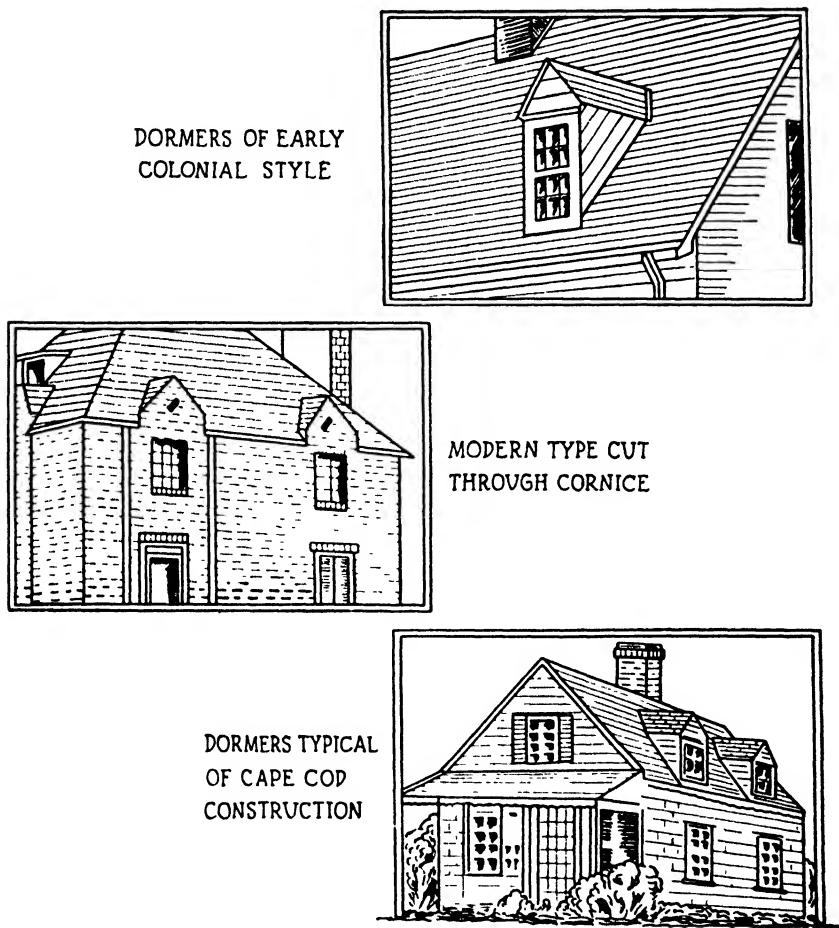


Fig. 99.

Good construction around window and door frames is essential to good building. Where frames are to be set, studding must be cut away and its equivalent strength replaced by doubling the studs on each side of the opening. A double header should be used at the top and, in cases of wide openings, the opening should be trussed

(Fig. 100). Frames should be made as airtight as possible around the edges between the frame and the wall. A good method is to provide a false casing on the outside which will set in flush with the sheathing. Then tack building paper over the casing and the

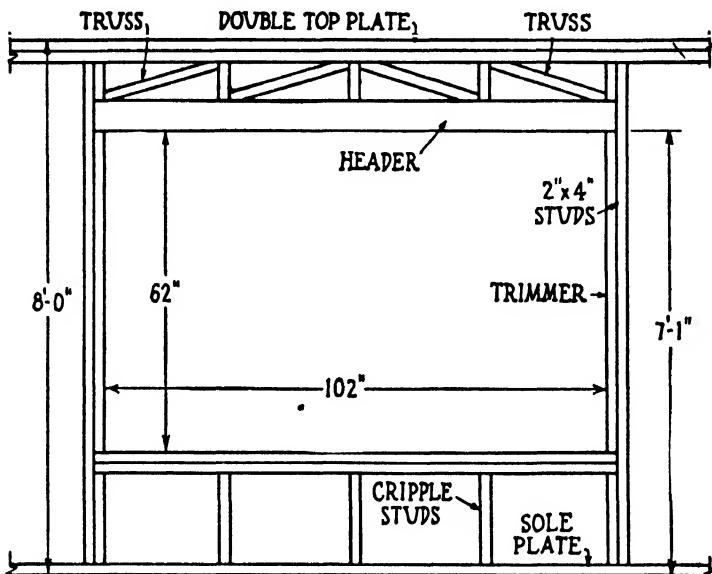


Fig. 100.—A rough opening for a 24 by 26 triple window. A double header should be used at the top, and, in cases of wide openings, the openings should be trussed. When studding is cut away, strength of the wall is lost. This strength must be replaced by doubling the studs on each side of the opening.

sheathing. The outside finished casing is then placed over the paper. The frame should be set plumb and level and be well braced and wedged around the edges. Fireproof insulation should be stuffed in any spaces or openings left around the frame.

Window frames may be either single or multiple; stationary or double hung, check rail, or casement. Casements may open in or out. Double-hung windows may be fitted with weights or pulleys or overhead balances (Fig. 101).

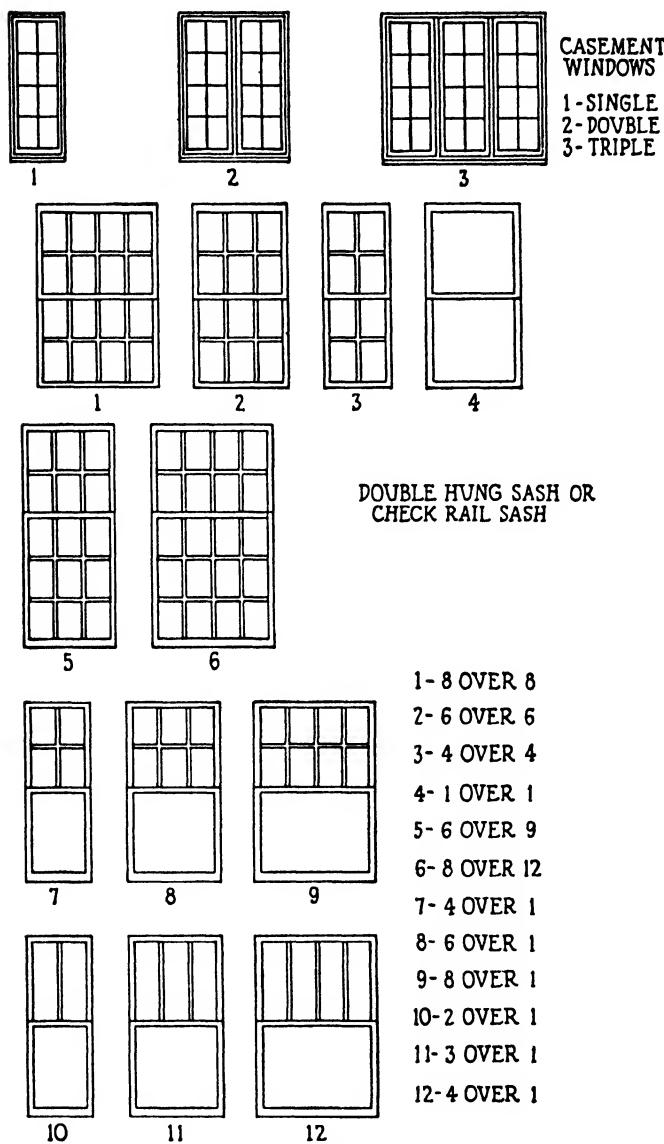


Fig. 101.

How to set a double-hung window frame

1. Check the rough opening and see that it is at least 10 in. larger each way than the window frame. This allowance is standard and provides for weights, plumbing, and adjustments.
2. Tack a strip of heavy building paper about 12 in. wide all around the outside of the opening, over the sheathing (Fig. 102).
3. Set the frame in place, allowing the subsill to rest on the rough frame at the bottom.
4. Adjust the top of the frame to the required height. All doors and windows should be the same height, rough and finished.
5. If wedging is necessary in order to level, use shingles or lath. This, however, should be only temporary or until the frame is nailed in place.
6. Level the subsill and hold the frame in place.
7. Put one nail through the outside casing into the sheathing at the lower corners.
8. Plumb the two side casings and nail on to the wall well from the outside.
9. Use 6d or 8d common nails.

Window sash. Sashes are usually that portion of the window that holds or contains the glass. Their purpose is to provide an opening to admit light and still protect the interior of a house from cold, heat, dust, wind, etc.

Size of Sash. The sash size is determined by the size of the glass (Fig. 103). Over-all dimensions are generally standard and made to fit standard construction frames. The thickness of sash is usually $1\frac{1}{8}$, $1\frac{3}{8}$, or $1\frac{3}{4}$ in. The $1\frac{3}{8}$ -in. sash is generally used in frame-house construction.

A window is composed of an upper and a lower sash which slide vertically. These sashes are counterbalanced by weights hung on cord or chain or by means of sash balances. A sash is one piece. It may slide up and down or swing in and out, or may be stationary.

In giving the size of a sash, the width of the glass is always given first, then the height, then the number of pieces of glass, or lights.

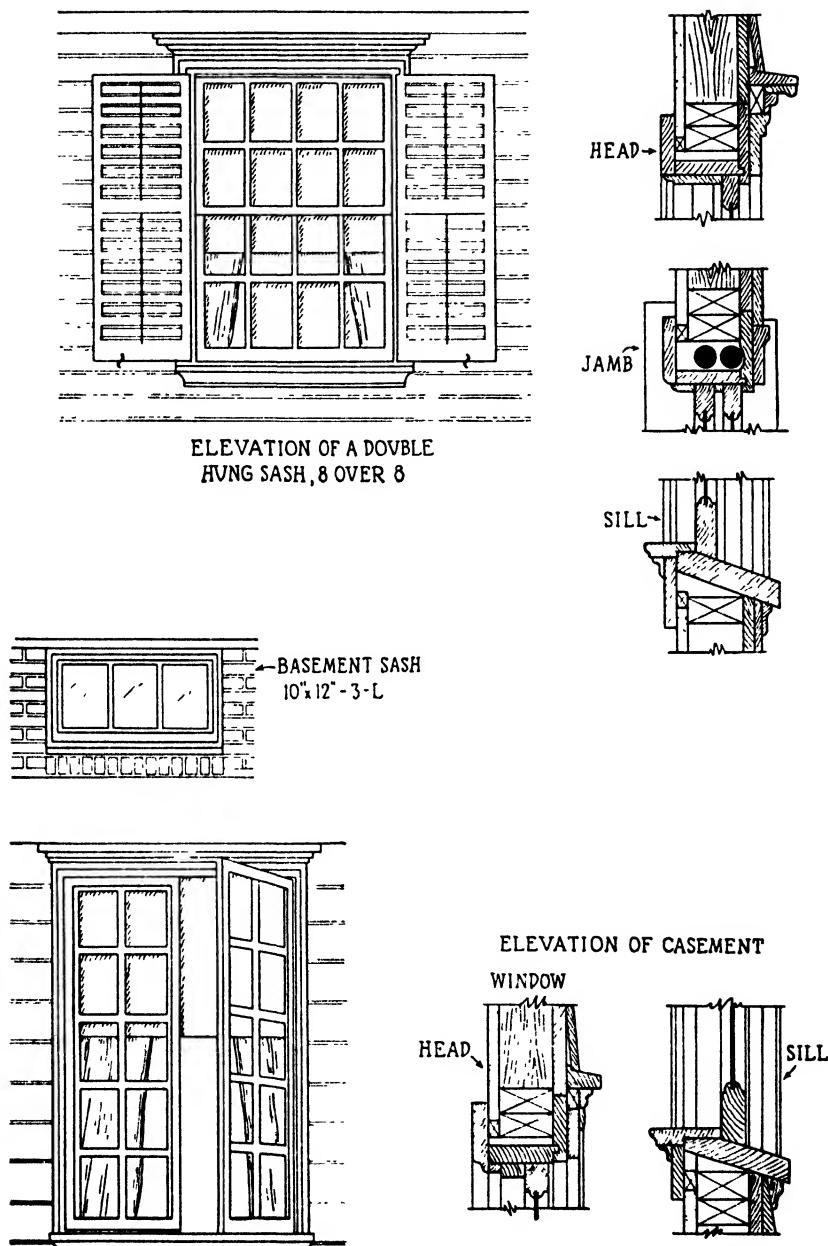


Fig. 102.

Thus a sash might be spoken of as a 24 by 26 by 1 light. This means that the glass itself was 24 by 26 in. and that there was only one piece of glass. However, the sash would be larger than 24 by 26 in. because

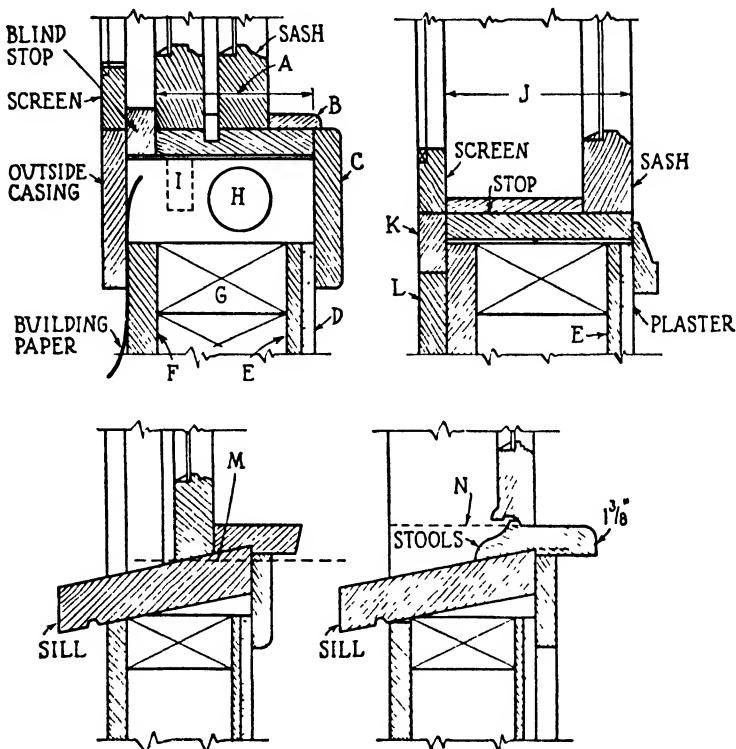


Fig. 103.—A. Width of pulley style, B. inside stop, C. inside casing, D. plaster, E. lath, F. siding, G. studs, H. weight, I. optional sash balance, J. width of casement jamb, K. outside casing, L. siding, M. double-hung frame measured from here, N. casement frames measured from here.

of the frame around the glass. For the frame of a two-light window with a $1\frac{3}{8}$ in. check rail, add 4 in. to the width and 6 in. to the length.

Example. A two-light window has a glass size of 24 by 26, meaning that the glass in each sash is 24 in. wide and 26 in. high. Find the size of the window frame.

Solution. $24 + 4 = 28$, or 2 ft. 4 in., the width. $26 \times 2 = 52$, or 52 in. $52 + 6 = 58$, or 4 ft. 10 in., the length.

Therefore, the window-frame size for these sash would be 2 ft. 4 in. by 4 ft. 10 in. D.H., or double hung.

Types of sash. There are two general types of wood sash (Fig. 102): (1) fixed or permanent, (2) movable.

FIXED SASH are removable only with the aid of a carpenter.

MOVABLE SASH may be of the variety that slide up and down in channels in the frame, or of the casement type that swing in or out and are hinged at the side. Sliding sash are counterbalanced by weights, called "sash weights," their actual weight being equal to one-half that of each sash. For example, if a window sash weighs 12 lb., it would require two 6-lb. weights to counterbalance it. These weights are hung in the frame by sash cords passing over a pulley in the frame and attached to the side of the sash.

Other types are spring balances attached at the top of the frame and supporting the sash by long steel ribbons secured to the side of the sash.

Sash are classified according to the number of lights: single or divided. Divided sash may have an indefinite number of patterns, usually determined by the kind of architecture.

Perhaps nowhere else is the most careful workmanship so essential as in the fitting of window sash. They must be properly fitted and carefully balanced. Weights that are too light will allow a sash to fall; those too heavy will prevent it from properly seating. Improper balance causes broken glass. If the sash are fitted too loosely, they develop rattle and permit dust, air, and moisture to filter in around them; if *too tightly*, they are an endless source of trouble in raising and lowering. Whenever possible, a good grade of metal weather strip should be used on all movable sash. A great many manufacturers are now producing a frame, sash, and weather strip, all in one combination. These are set into the frame wall in one unit and are proving very satisfactory as far as good construction and operation are concerned.

How to fit a double-hung wood sash

1. Prepare the sash cords, chains, or balances that are to be used. If cords are used, tie them to the weights, run them through the pulleys at the top, and tie a knot in the end of each. This knot will be set in the side of the sash in a recess made to receive it.

2. The length of the cord can be determined by placing the sash in its position and measuring. When the inside sash is down in place, the weight for that sash should be near the top pulley. When the outside sash is up in place, the weight for it should be down, not quite touching the bottom.

3. Fit the outside top sash first.

4. Do not fit it too tightly, allow for swelling.

5. Use a sharp plane for squaring.

6. Remove the parting bead on one side of the frame to enable you to put the sash into place. This is the strip about $\frac{1}{2}$ by $\frac{3}{4}$ in. which is grooved into the frame on each side, separating the two sash.

7. Notch out each end of the check rail as far as the parting bead extends beyond the frame. This should be done very accurately to prevent bad fitting which in turn would either let in wind and cold or, if too tight, cause the sash to slide hard (Fig. 103a).

8. When the sash is fitted, put it in place, replace the parting beads, and attach sash cords to the sides.

9. Plane and fit the inside bottom sash next for easy operation.

10. Fit the sides of it first.

11. After the sides have been fitted, set the sash in place and determine how much, if any, need come off the bottom other than the bevel that is always planed on to match the slant of the window sill (Fig. 103).

12. The two check rails must come together and be even at the middle of the window. If not, the window locks will not meet or be workable.

13. If the rails do not match, scribe off the necessary amount at the bottom, taking care to keep the same bevel on the bottom edge of the sash.

14. When the lower sash is fitted, put it in place, secure the sash cords, and check both sash for easy operation.

Doors. Doors are the shutters for doorways. Their purpose is to provide a means of closing or shutting off one room from another,

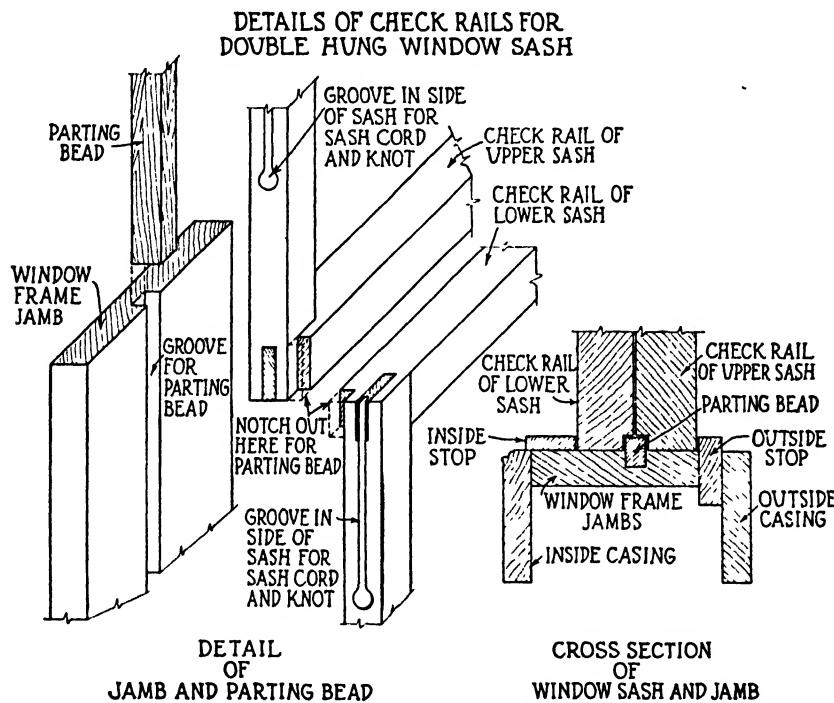


Fig. 103a.

or enclosing a house or other compartment. There are various types as follows:

1. Interior doors, used inside a building.
2. Exterior doors, used on outside door openings.
3. French doors, used inside or outside.
4. Cabinet doors, for cases, cupboards, etc.
5. Garage doors, for garages and the entrances to them.

Door sizes. Regular stock sizes run from 2 ft. 6 in. to 3 ft. 6 in. wide, and from 6 to 7 ft. long. The most commonly used doors are

from 2 ft. 6 in. to 2 ft. 8 in. wide, and 6 ft. to 6 ft. 8 in. long. INSIDE DOORS usually are $1\frac{3}{8}$ in. thick. OUTSIDE DOORS usually are $1\frac{3}{4}$ in. thick. CABINET DOORS vary in size and thickness depending upon their use (Fig. 104). GARAGE DOORS are usually $1\frac{3}{4}$ in. thick and vary in width depending upon the number of doors to be used in an opening. The total width for standard garage doors is 8 ft. If three sections are used, each will be 32 in. wide (Fig. 105).

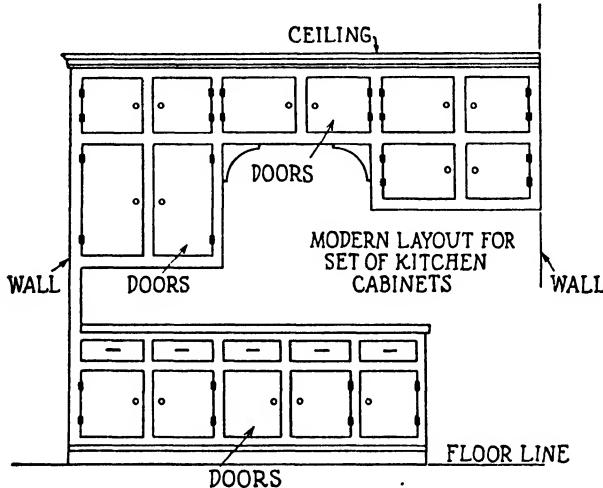


Fig. 104.—Cabinet doors vary in size and thickness depending upon their use. The above cabinet doors are $\frac{3}{4}$ in. thick.

Grades. Doors are usually divided into four grades for quality: No. 1, No. 2, No. 3, and No. 4. Numbers 1 and 2 are generally used for most house work.

How to fit and hang doors. The parts of a door are the stiles, rails, and panels (Fig. 106). Sometimes panels are replaced by glass panes.

1. From the blueprint determine whether the door swings to the right or the left.
2. Mark around with a square and saw off the lugs (Fig. 106).
3. Hold the door to place and check for size and squareness.
4. Plane one edge of the door until it fits the frame or jamb on the side it is to be hung.

5. Plane the top edge until it fits the head of the jamb.
6. Hold the door in place against the fitted edge and fitted top and scribe the other edge from the inside of the other jamb.
7. The exact length of door need not be determined until after it is hung and the finish floors are laid. After this is done, scribe the bottom with the floor and mark the allowance of about $\frac{1}{2}$ in.

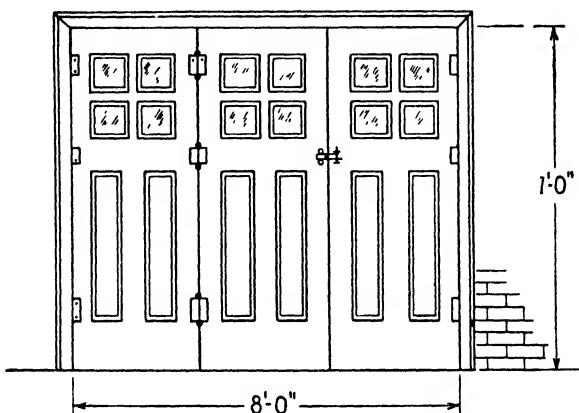


Fig. 105.—Three-fold swinging garage doors. These doors are made in sections and hinged at the sides. Each section is 32 in. wide. Heights may vary but are generally 7 ft.

8. Cut off and plane down the bottom of the door.

A door should be fitted with about $\frac{1}{8}$ in. of space or “play” all around it. This, however, should be uniform and even. The free edge of the door will need to be planed somewhat lower at the back arris than at the front, to prevent the door from rubbing as it is opened.

How to hinge a door

1. Place the door in position against the door stops.
2. Be sure to have proper allowance around the door.
3. Block it in place temporarily.
4. Measure down from the top and up from the bottom to locate the hinges.

5. Mark these points with a sharp knife. (The top hinge is usually set down 7 in.; bottom hinge, set up 11 in.)

6. Remove the door and chisel out gains on the frame and the door, if the hinges are loose butts. If it is a half-surface hinge, gain only on the jamb.

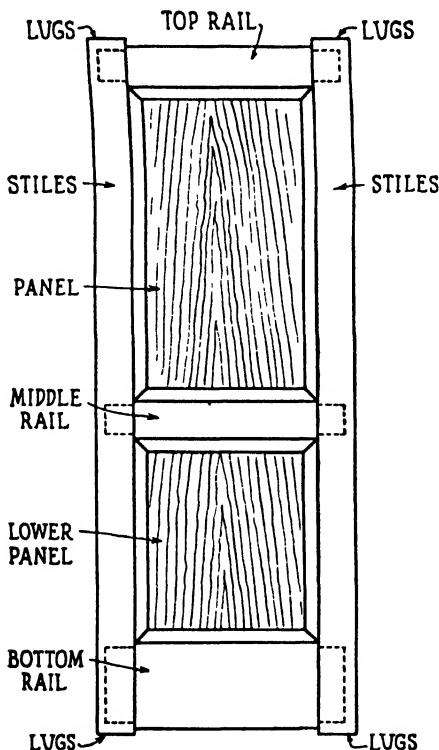


Fig. 106.

7. Screw the hinges in place on the jamb and the door, if they are loose butts.

8. If a half-surface hinge is used, screw it in place on the jamb and then place the door in position, block it, and screw onto the door the surface half of the hinge.

Locks are usually mortised in. The type of lock will generally suggest the method of installation.

6

GLASS—GLAZING— INSULATION

GLASS

Glass is a transparent material used in window sash to admit light and still provide protection to the interior of a house from cold, heat, dust, etc. It has recently become widely used for decoration purposes in various types of architecture. Regular stock sizes vary in inches from 6 to 16 in.; above this by even inches up to 60 in. in width and 70 in. in height for double strength, 34 by 50 in. for single strength.

Glass comes in three grades: (1) single strength, (2) double strength, (3) plate. *Single-strength* glass may be as thin as $\frac{1}{16}$ in. and vary in thickness up to $\frac{1}{8}$ in. *Double-strength* glass will run almost uniformly $\frac{1}{8}$ in. thick. *Plate* glass is the highest grade of window glass, being cast in large sheets on a flat table and then polished. It will vary in thickness from $\frac{1}{4}$ to $\frac{5}{16}$ in.

Both single- and double-strength glass are sorted into three qualities, the classification depending upon color, brilliancy, and flaws:

- “AA,” the best quality
- “A,” the second quality
- “B,” the third quality

“A” and “B” are most commonly used for house construction.

Manufacture of glass. Glass is made by fusing under intense heat a mixture of soda, lime, and sand. For blown glass the ingredients are melted together in vats in huge furnaces. When the mass is ready, it is blown either by men or by machinery into large cylinders of the desired thickness. It is then opened and flattened by heating, and finally inspected and cut into the desired sizes.

GLAZING

How to glaze a sash. Placing glass in a sash is called "glazing." To glaze a window, remove and place the sash on a table or bench with the rabbet side up. If a broken glass is being replaced, the old putty and glass should be removed. *Clean* out all the old putty and glazier points. The rabbet will probably be found to be dry and hard. If it is, prime it with linseed oil or thin paint and let it soak in well. This will cause the putty to adhere more readily and prevent the dry frame from drawing all the oil out of the putty. Next, place the pane of glass in the opening. If the glass needs to be cut, proceed as follows:

1. Measure the glass.
2. Plan it $\frac{1}{8}$ in. smaller than the opening.
3. Lay a straightedge on the glass and hold it firmly in place.
4. Hold the cutter firmly against the straightedge and start to cut at the farther edge.
5. Draw the cutter toward you in a firm rapid motion with even pressure.
6. Place the line made by the cutter over the edge of a table top or bench.
7. Press down gently on the projection.
8. If the glass does not break readily, tap the underside gently with the cutter and try again.

After the pane has been cut, place it in the opening and proceed to glaze. Press glazier points into the frame to hold the pane in

place and apply the putty, feeding it down under the putty knife as it is drawn along.

Putty is composed of whiting, white lead, and linseed oil. If left in the open, it will become hard. Putty should be kept in a closed container and kept covered with a thin skim of linseed oil.

INSULATION

Home insulation is effected by heat insulation, which is a material having a high degree of heat and wind resistance. Its proper installation in a wall, door, or ceiling prevents the passage of heat; that is, a smaller amount of heat will pass through an insulated wall in a given time than through one that is not insulated. Thus less fuel will be needed to heat an insulated room or building.

Generally speaking, there are two ways in which heat is lost from a room or house: (1) by the infiltration of cold air around windows, doors, cracks, etc., (2) by direct transmission through the building materials.

It is possible for both types of heat losses to occur at the same window or door: part of it around the window at poorly fitted points and part of it directly through glass.

Methods of preventing infiltration of cold air:

1. By well-fitted doors
2. By well-fitted windows
3. By using shiplap siding and sheathing
4. By using good-grade building paper
5. By using good-grade metal weather strip
6. By using storm sash

Methods of preventing transmission of heat:

1. By thicker surface resistance
2. By using flexible insulation between wall studs
3. By using flexible insulation between ceiling joists
4. By using flexible insulation between rafters
5. By using rigid insulation board for sheathing

Many types of insulation are now available for use in building construction. Following are some of the readily attainable insulation materials and their recommended uses:

1. Rock wools and fibers:

- a. Loose—attic between joists
- b. Granulated—attic between joists
- c. Rolls—side walls or attic
- d. Bolts—side walls and ceilings

2. Wallboards:

- a. Board—walls and ceilings, inside
- b. Sheathing—roof and outside walls
- c. Plank—inside rooms for finish wall
- d. Lath—plaster base
- e. Tile—acoustics

3. Papers:

- a. Felt—floors, ceilings, walls, roofs
- b. Red rosin—over sheathing
- c. Black saturated—outside walls and roofs

Often insulation is installed after a house has been built for some time. The proper method is shown in Fig. 107. However, this insulation is usually of the granulated type and can be blown in or forced down between the studs by air pressure.

Attic insulation. One of the best kinds of attic insulation is the blanket type. It usually comes in rolls and is placed directly between the ceiling joists, rafters, or studs, as the case demands. In order to secure the greatest effectiveness of this installation, two things are most necessary:

1. Proper installation of the blanket (Fig. 108).
2. Sufficient ventilation of the attic space between the insulation and the roof (Fig. 109).

Advantages of attic insulation

1. Attic insulation effects appreciable fuel savings and increased comfort during the heating season.



Fig. 107.—Insulation in the home. A modern method of installing insulation in a home after it has been built. This method is very good and is being used a great deal. In new-home construction the insulation is usually built in.

2. With it the entire house can be made cooler and more comfortable during the summer months.

3. Insulation of the ceiling and roof construction is very effective because of the higher temperature at the ceiling line during the heating season, owing to the fact that warm air has a tendency to rise. In an uninsulated house, this temperature difference from floor

to ceiling may be as high as 15 deg. This causes a greater temperature difference between the air at the ceiling and outside, and a resulting higher heat loss through walls.

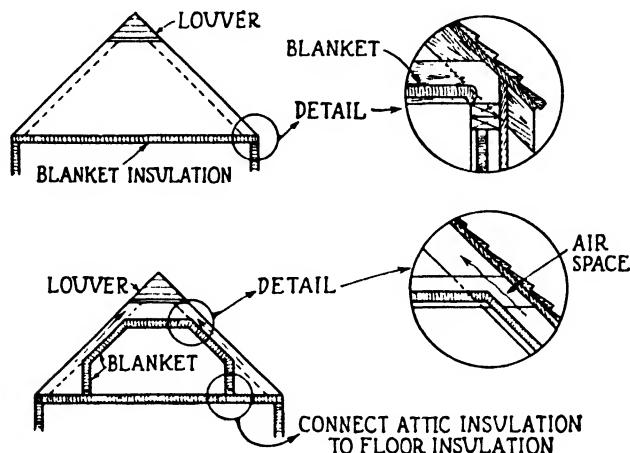


Fig. 108.

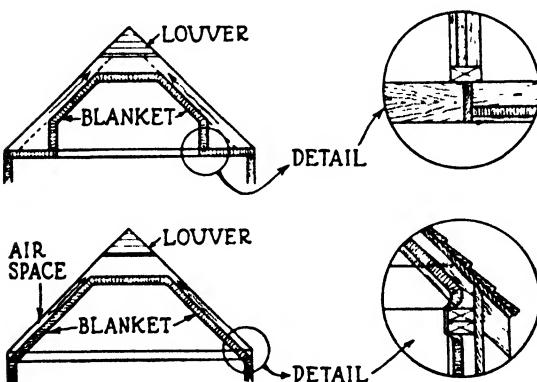
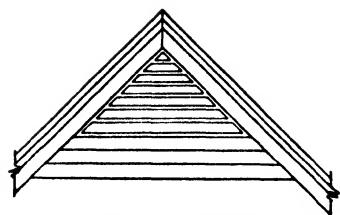
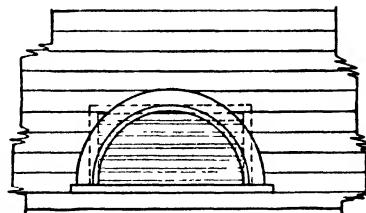


Fig. 109.—There should always be sufficient space between the insulation and the roof to permit the passage of air to the louver.

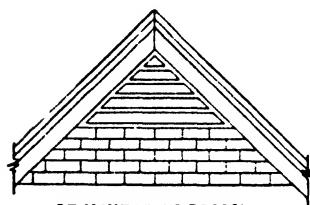
4. Attic insulation increases the temperature of the ceiling surface during the heating season more nearly to that of the room air temperature; therefore, drafts are reduced, and excessive loss of radiated heat from occupants to cold ceiling surface is reduced.



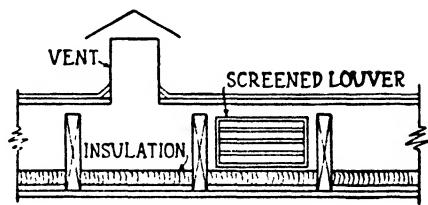
PEAKHEAD LOUVER



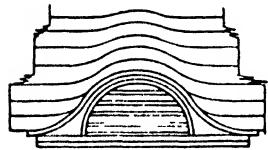
CIRCLE LOUVER



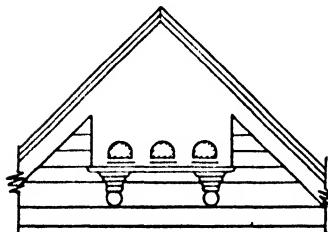
PEAKHEAD IN BRICK



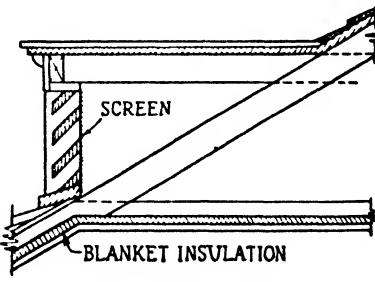
FLAT ROOF VENTILATOR



EYEBROW LOUVER



DOVE-COTE VENTILATOR



ROOF VENTILATOR

Fig. 110.

5. Uninsulated ceilings and roofs of ordinary construction offer in themselves little resistance to the passage of heat.

6. Many factors that contribute to excessive transfer of heat through roofs are not reckoned with in theoretical calculation, for instance, poor and open construction at the eaves.

7. The attic space is usually accessible for the easy installation of insulation.

Attic ventilation. One of the most common methods of ventilating an attic is with the use of wood louver frames, some of which are used for the purpose of ventilating alone, while others are used for decorative purposes also. There are many types, sizes, and shapes of louvers. Following are the points to consider when building or designing a louver.

1. The minimum net open area should be $\frac{1}{4}$ sq. in. per sq. ft. of ceiling area in the attic.

2. Most louver frames are usually 5 in. wide.

3. Rabbet out the back edge for a screen or door, or both.

4. Use $\frac{3}{4}$ -in. slats and space them about $1\frac{3}{4}$ in. apart.

5. Provide sufficient slant or slope to the slats to prevent rain from driving in.

6. For best operation, place the louver as near the top of a gable as possible.

Types of louvers. Some of the more commonly used louvers are as follows (Fig. 110):

1. Peakhead, in frame wall

2. Peakhead, in brick wall

3. Eyebrow louver

4. Dovecot louver

5. Half-circle louver

6. Flat-roof louver

7. Flat dormer louver

7

L U M B E R — G R A D I N G A N D M E A S U R I N G

Classification. In general there are four classes of lumber:

1. Hardwood factory, for furniture, fixtures, etc.
2. Softwood factory, for doors, sash, cabinets, etc.
3. Yard lumber, for building and industrial work.
4. Structural timbers, sizes over 6 in. wide and thick.

Yard lumber is manufactured primarily for the building trades. It is worked into various forms, shapes, and sizes at the planing mills. This includes lumber for framework such as 2 by 4's, 2 by 6's, 2 by 8's, 2 by 10's, 2 by 12's, and all other framework sizes. It includes common boards, siding, sheathing, ceiling, partition lumber, flooring, moldings, casings, baseboards, shiplap, and all other general dimension stock. Yard lumber includes such woods as white pine, yellow pine, fir, spruce, redwood, and occasionally oak.

The accompanying classification is now being used for grading yard lumber.

Defects and blemishes. A *defect* is considered to be any irregularity found in or on a piece that would lower its strength or durability. A *blemish* may be considered as any mars, scratches, or un-

YARD LUMBER CLASSIFICATION TABLE

Total products of a typical log arranged in a series according to quality as determined by appearance.	1. <i>Select lumber</i> of a very good appearance and with very good finishing qualities.	Suitable for natural finishes	<i>Grade A.</i> Practically free from defects.
		Suitable for paint finishes	<i>Grade B.</i> Allows a few small defects or blemishes.
	2. <i>Common lumber</i> containing defects or blemishes which detract from a finished appearance but which is still suitable for general utility and construction purposes.	Suitable for use without waste	<i>Grade C.</i> Allows a limited number of small defects or blemishes that can be covered with paint.
		Lumber permitting waste	<i>Grade D.</i> Allows any number of defects or blemishes that do not detract from a finished appearance when painted.
		Suitable for use without waste	<i>No. 1 Common.</i> Sound and tight knotted stock. May be considered watertight stock.
		Lumber permitting waste	<i>No. 2 Common.</i> Allows large and coarse defects. May be considered graintight lumber.
		Lumber permitting waste	<i>No. 3 Common.</i> Allows larger and coarser defects than No. 2 and some knotholes.
		Lumber permitting waste	<i>No. 4 Common.</i> Low-quality lumber admitting the coarsest defects such as rot and holes.

satisfactory appearance of the wood not classed as a defect. Defects and blemishes may be classed as follows:

1. Knots
2. Holes
3. Decay
4. Splits
5. Warp
6. Pitch pockets
7. Streaks
8. Cross grain
9. Checks
10. Bad milling
11. Bark
12. Pith
13. Discoloration
14. Gum pockets

A complete list of grading rules in detail may be secured from any lumber manufacturer's association. American lumber standards have been adopted by most of them.

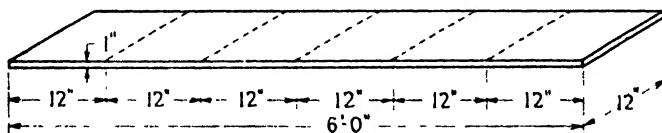


Fig. 111.

Lumber terms. In order to be able to measure lumber quickly and accurately, it is necessary to understand the following terms and their application to lumber:

BOARD FOOT. Lumber is measured by the board foot, which is a piece of lumber having an area of 1 sq. ft. on its flat surface and a thickness of 1 in. or less (Fig. 111).

FEET. Feet is generally taken to mean board feet unless reference is made to linear feet.

LINEAR FEET. Linear feet represent only the length of a board or piece, not any certain width.

ROUGH STOCK. Rough stock means lumber that is cut up into pieces larger than its intended use, or lumber that has not been dressed.

DRESSED. By dressing lumber we mean planing or smoothing it. Lumber is cut and sawed in a sawmill. Since this process leaves the surface rough, it is necessary to dress the lumber, or plane it down to a smooth surface. This is done in a planing mill. It may be dressed on one face or both faces, or on both faces and both edges.

S. 1 S. Lumber dressed on one face is indicated by marking "S. 1 S.," which means surfaced on one side.

S. 2 S. Lumber dressed on two faces will be indicated by marking "S. 2 S.," meaning surfaced on two sides.

S. 4 S. Lumber dressed on both sides and both edges will be marked "S. 4 S."

SIZE. When lumber is dressed, it loses in size the amount planed off in shavings. A piece sawed at the mill 2 in. thick and 10 in. wide is called a "2 by 10." However, when it is dressed, it becomes $1\frac{3}{4}$ by $9\frac{5}{8}$ in., but it is still called a "2 by 10." In measuring the *width* of common rough lumber, a fraction of an inch equal to or greater than $\frac{1}{2}$ in. is counted as a whole inch, while a fraction less than $\frac{1}{2}$ in. is neglected. For example, a board $6\frac{1}{2}$ in. wide would be called 7 in. wide. A board $6\frac{5}{8}$ in. would be called 7 in. wide, and a board $6\frac{1}{4}$ in. would be called 6 in. wide.

SURFACED. A term generally applied to lumber that has been dressed only on the faces.

JOINTED. Lumber that has been dressed on the edges is said to be "jointed."

LUMBER. Pieces 5 in. or less in thickness.

TIMBER. The term applied to pieces more than 5 in. in thickness; also to standing trees. We may also speak of a piece as having in it "good timber."

BOARDS. Boards are pieces less than 2 in. thick and 8 in. or more wide.

PLANKS. Planks are yard lumber from 2 to 4 in. in thickness and 8 in. or over in width.

STRIPS. Strips are pieces less than 2 in. thick and not 8 in. wide.

SCANTLINGS. Pieces from 2 to 5 in. thick and less than 8 in. wide.

STANDARD LENGTHS. Most yard lumber is sold in standard lengths, as 10, 12, 14, 16, 18 ft., etc. When several boards of the same length but of different widths are to be measured, it is convenient to add all the widths together and figure the lot as one board.

TABLE 8.—TO CALCULATE BOARD MEASURE

1 in. thick or less

Pieces 3" wide contain $\frac{1}{4}$ as many feet as they are long

Pieces 4" wide contain $\frac{1}{3}$ as many feet as they are long

Pieces 6" wide contain $\frac{1}{2}$ as many feet as they are long

Pieces 9" wide contain $\frac{3}{4}$ as many feet as they are long

Pieces 12" wide contain just as many feet as they are long

Pieces 15" wide contain $1\frac{1}{4}$ as many feet as they are long

How to find the number of board feet. Multiply the number of square feet in the surface of a piece of lumber by the number of inches in its thickness, counting a thickness less than 1 in. the same as 1 in.

Example 1. Find the number of board feet in a piece of lumber 2 in. thick, 10 in. wide, and 6 ft. long.

$$\text{Solution. } \frac{2 \times 10 \times 6}{12} = 10, \text{ or } 10 \text{ bd. ft.}$$

The above method is known as the “cancellation” method. The whole process is expressed as a fraction. The numerator has three figures: the thickness in inches, the width in inches, and the length in *feet*. If these three dimensions are expressed in *inches*, then their product would have to be divided by 144 instead of 12, since there are 144 sq. in. in 1 sq. ft.

Example 2. Find the number of board feet in a piece of lumber 2 in. thick, 10 in. wide, and 102 in. long.

Solution.
$$\frac{2 \times 10 \times 102}{144} = 14\frac{1}{8}, \text{ or } 14\frac{1}{8} \text{ bd. ft.}$$

Example 3. Find the total number of board feet in the following pieces: 21 pieces, 1 in. thick, 4 in. wide, and 9 ft. long.

Solution.
$$\frac{21 \times 1 \times 4 \times 9}{12} = 63, \text{ or } 63 \text{ bd. ft.}$$

8

SCAFFOLDS AND SAFETY MEASURES

SCAFFOLDS

In practically all stages of construction, scaffolds of various types are needed. Each kind of work requires its own type of scaffold. A strong, well-built, and safe platform built at the right height enables a man to do more work and do it better and more efficiently in less time. However, on the small construction job, building a good scaffold usually takes more time than does the actual job itself. The material used for scaffolding should be clean, clear, and free from knots and imperfections. It should be straight-grained and not easily broken.

Types of scaffolds. Scaffolds may be either of the following types: (1) swinging or (2) fixed. Scaffolds may either be swung from some point above the working level, or be built up to the working level from a firm and substantial base or foundation. For the security of the workman employed, all types should comply with the safety laws. Care should be taken to see that the structure is built to protect not only the men working on it but also those working under it. Guard rails built about $3\frac{1}{2}$ or 4 ft. high at the back of the platform should be provided to prevent the men from

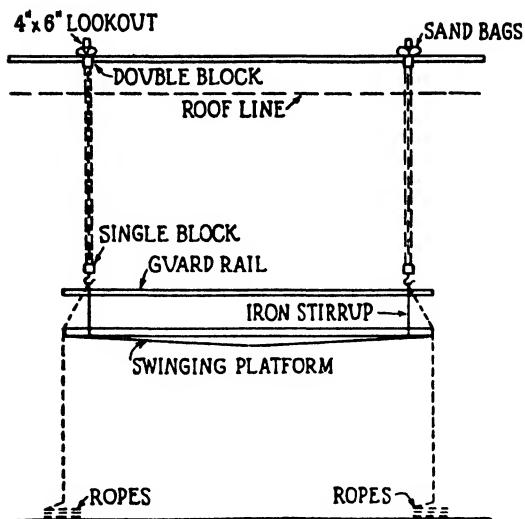


Fig. 112.

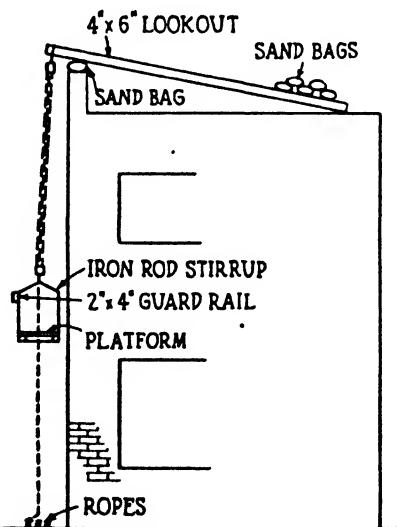


Fig. 113.

falling off. Foot boards should be laid close enough together to prevent tools and materials from falling through.

Swinging scaffolds. *Swinging* or suspended scaffolds are generally used by painters (Fig. 112). They are used on high flat-top buildings or those too high to reach from an extension ladder. Such a scaffold consists of a platform supported by blocks and falls which

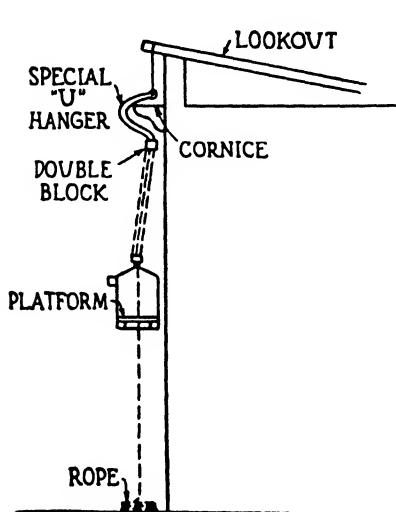


Fig. 114.

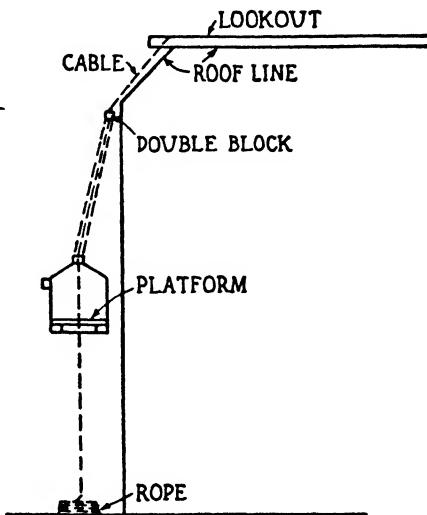


Fig. 115.

are fastened to 4- by 6-in. lookouts that extend out over the edge of the wall (Fig. 113). The inside ends of these lookouts are generally weighted down with sandbags or other suitable weights.

Sometimes a building with a wide cornice will require a special U hanger in order to prevent injury to the cornice (Fig. 114). Such a device will hang in close to the wall.

The *gable* or *sloped-back roof* is generally difficult to provide with a swinging scaffold. This can be done, however, with a double block and cable, as shown in Fig. 115.

How to build a swinging scaffold and rigging. To build a swinging scaffold you will need two iron stirrups (Fig. 116), made of $\frac{3}{4}$ - or 1-in. iron rod. A smaller iron can be welded to the stirrup

near the top for the guard rail. The platform should be about 2 ft. wide and 18 ft. long (Fig. 117). Tapered 2- by 6-in. pieces with a No. 9 wire stretched around them will make the truss (Fig. 118). Use a 2 by 4 for the guard rail. Also two double blocks, two single blocks, and two $\frac{3}{4}$ -in. ropes of the desired length will be needed.

Test the scaffold before using it. Raise it a short distance from the ground and have two or three men, or something of equal

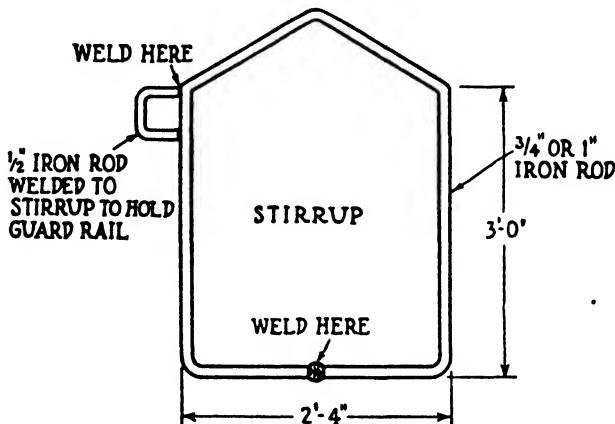


Fig. 116.

weight, try it out. Frequent inspections should be made of all scaffolding and rigging to prevent accidents.

Figure 119 shows a method of scaffolding a barn roof of the Gothic type. Use a 2 by 8, or a 2 by 10 for the walk board, and suspend it from above with ropes about 14 ft. long. Pass No. 9 wire through holes near the edges of the planks so that they will stay in place. Strap iron can be employed here instead of wire.

Fixed scaffolds. There are many types of fixed scaffolds. Following are some of the more commonly used: (1) pole scaffolds, (2) horse scaffolds, (3) outrigger scaffolds, (4) rolling platform scaffolds, (5) wood and metal jacks, (6) roof brackets, (7) ladder jacks, (8) putlogs, (9) roof jacks, (10) squares.

POLE SCAFFOLDS are rapidly being replaced by various types of smaller iron scaffolding which can be put up and taken down very

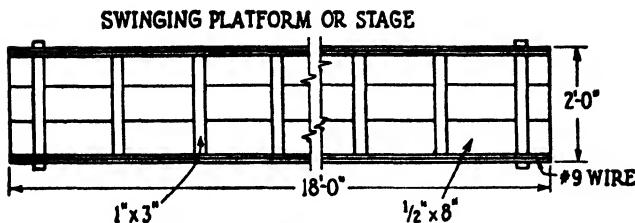


Fig. 117.

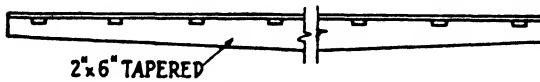


Fig. 118.

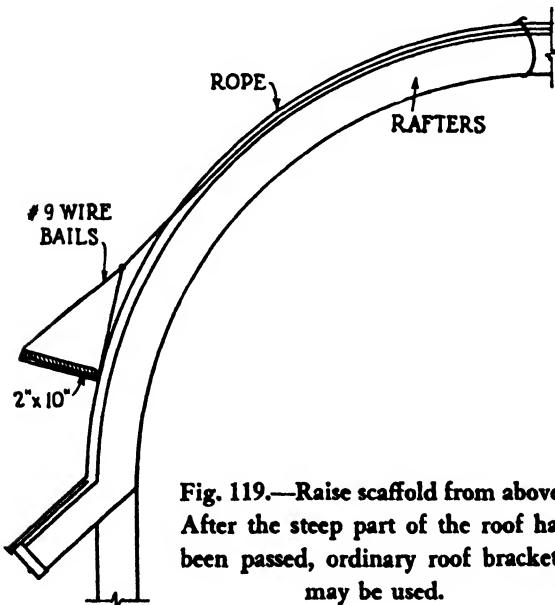


Fig. 119.—Raise scaffold from above.
After the steep part of the roof has
been passed, ordinary roof brackets
may be used.

quickly. However, it is still necessary at times and in some places to use pole scaffolds (Fig. 120). These are so called because they are built up from 2 by 4's or 2 by 6's set on end on a firm base. They

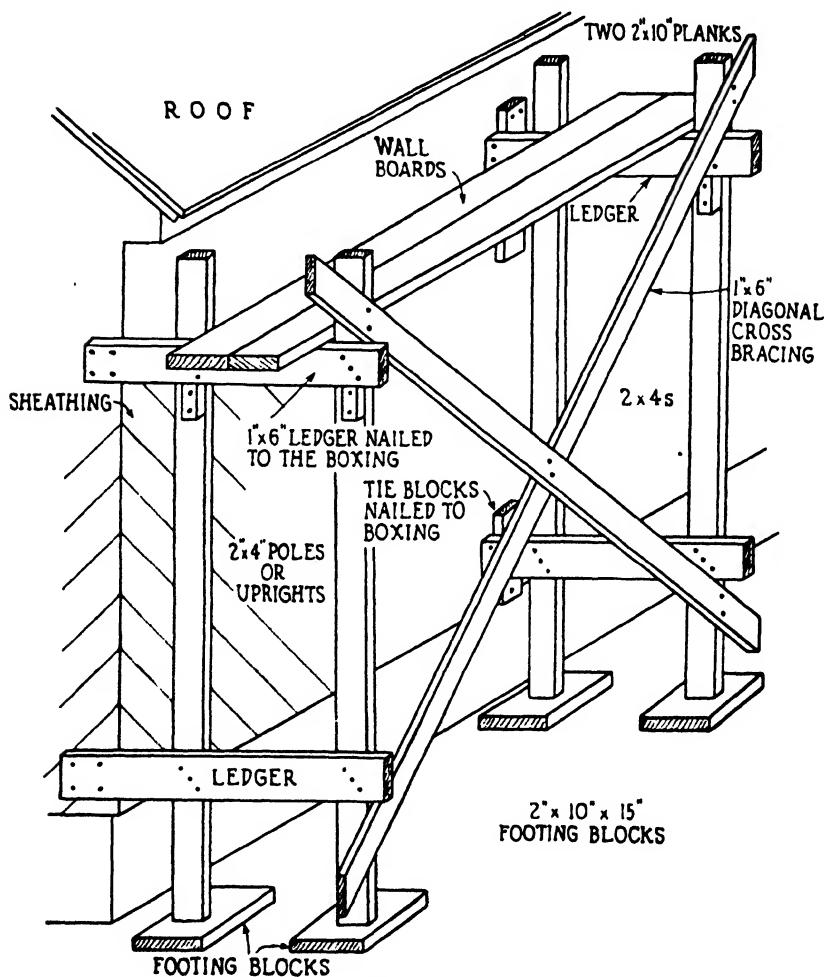


Fig. 120.

should be well tied together with ledgers to hold the foot boards and should also be well braced diagonally. All pole scaffolding should be tied well to the building and nailed securely. For brick buildings putlogs are used (Fig. 121).

HORSE SCAFFOLDS are used extensively in building construction as they are light, portable, and easy to make. Generally they are made demountable (Fig. 122). Horse scaffolds are made about 4 ft. high;

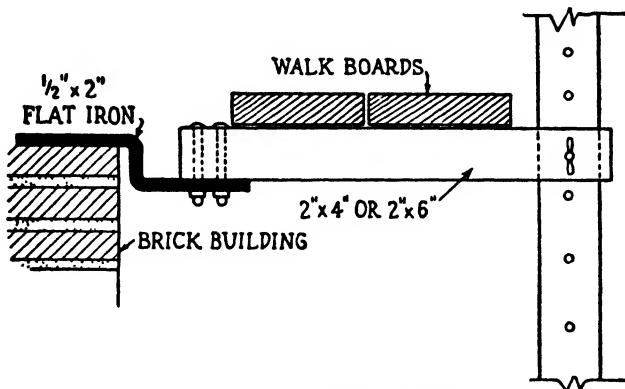


Fig. 121.—A putlog scaffold.

by placing one tier on top of another, increased height may be obtained. However, these scaffolds are not suitable for heavy loads.

OUTRIGGER SCAFFOLDS are platforms supported by beams or framework fastened to the floor or other parts of the frame of a building.

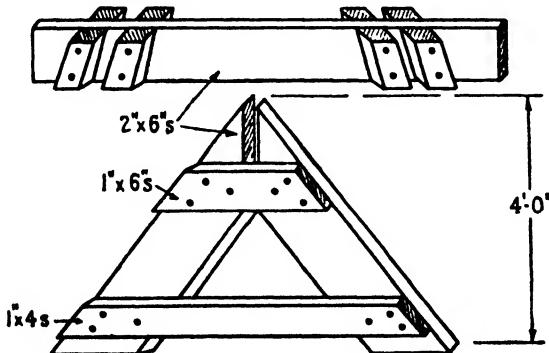


Fig. 122.—Horse scaffolds.

This type of scaffold is used where repairs are to be made at some point above ground level so high that building up from the ground would not be economical, as in repairing church steeples and towers.

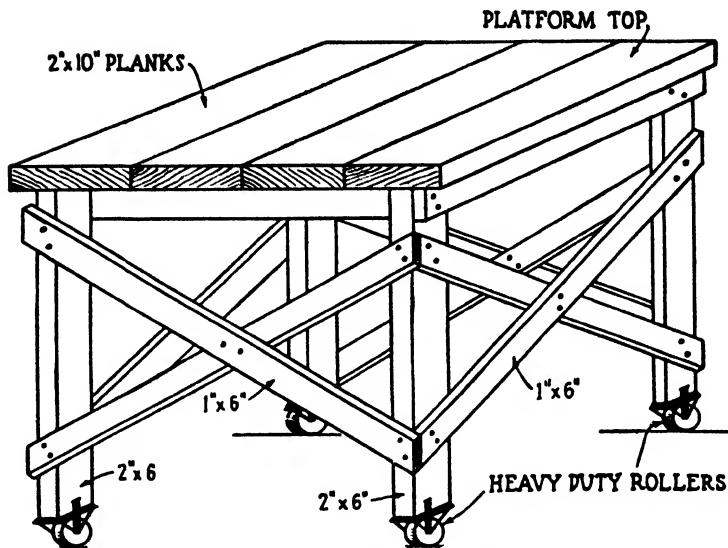


Fig. 123.—A rolling platform scaffold.

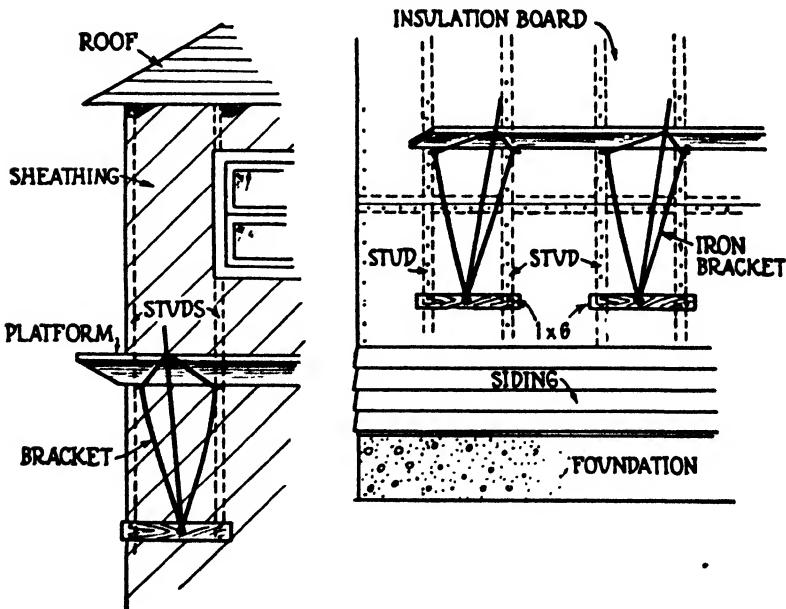


Fig. 124.—Nail the top ends of the brackets securely to the studs with 16d. common nails. Under the bottom end place a piece of 1 by 6 and nail it to the studs with 8d.-C.

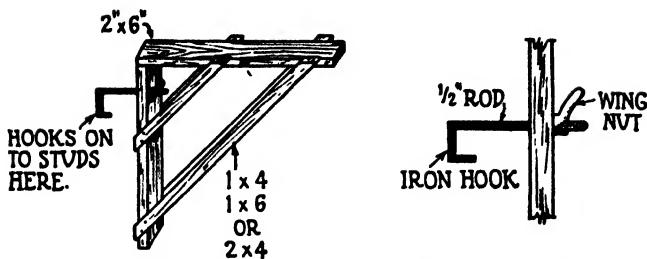


Fig. 125.—How to make wooden scaffold jacks.

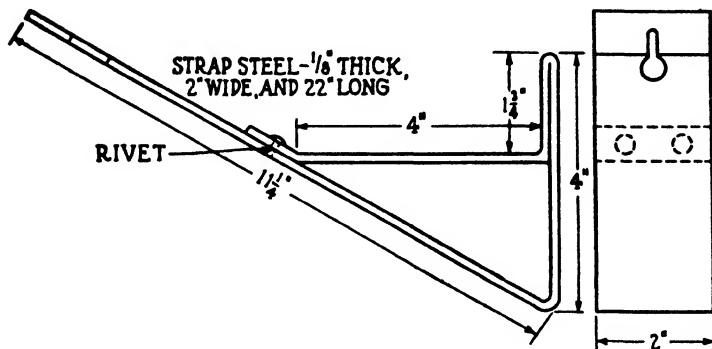


Fig. 126.

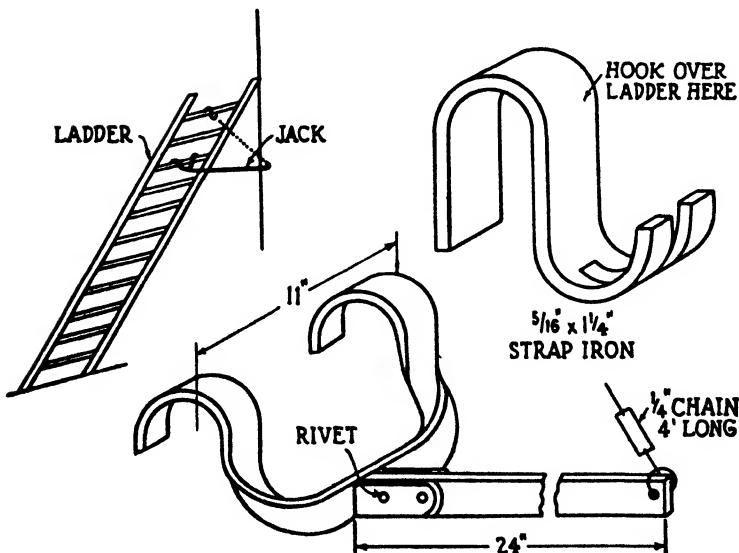


Fig. 127.

ROLLING PLATFORM SCAFFOLDS are used on inside work, usually where floors will permit (Fig. 123). The entire frame is constructed of 2 by 6's with 1- by 6-in. braces and 2- by 10-in. floor boards. A built-on ladder permits easy access.

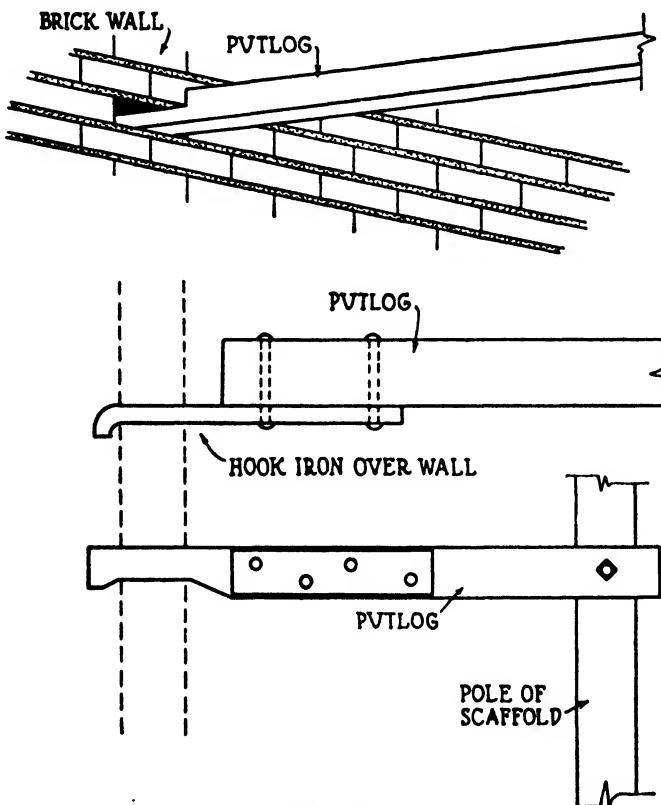


Fig. 128.

WOOD AND METAL JACKS are favorites with most carpenters because they are portable and easy to move from place to place (Fig. 124). Metal wall brackets are used to nail on siding, or sheathing, set window frames, and for many other types of work. The upper ends are nailed securely to the studs. The lower ends are nailed to a 1 by 6, which in turn is nailed to the studs. Wood jacks may also be made, as shown in Fig. 125.

ROOF BRACKETS are used mostly while laying shingles or roofing. There are many types made of iron and wood (Fig. 126). These brackets can usually be bought cheaper than one can make them.

LADDER JACKS are metal braces applied to the rounds of a ladder (Fig. 127). Two ladders are used, each with a jack on it, and these

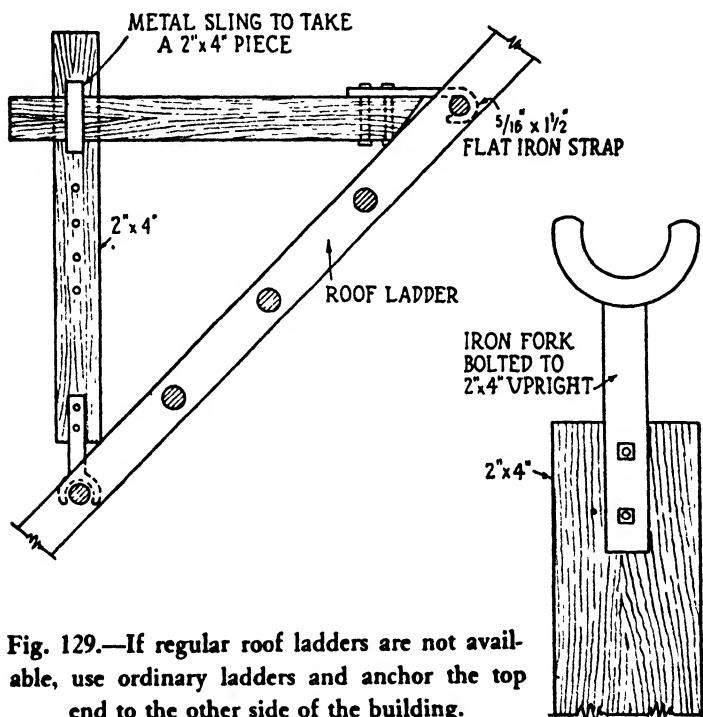


Fig. 129.—If regular roof ladders are not available, use ordinary ladders and anchor the top end to the other side of the building.

jacks carry a 2 by 10 for a walk board. This type of scaffold is not recommended for high construction work.

PUTLOGS are used on buildings constructed of brick or masonry, usually brick veneer buildings (Fig. 128). They are used with pole backs and can be adjustable or just nailed in place on the pole. When the work is completed, the putlog is removed by pulling it out and filling or pointing up the hole left by it.

ROOF JACKS (Fig. 129) are a type of roof scaffold that is easy to build, portable, and adjustable; also easy to take down and put up.

If roof ladders are not available, use ordinary ladders. Either wire one ladder to another at the top and hang it on the other side of the roof, or tie ropes to the tops of the ladders and anchor the ropes down on the other side of the building.

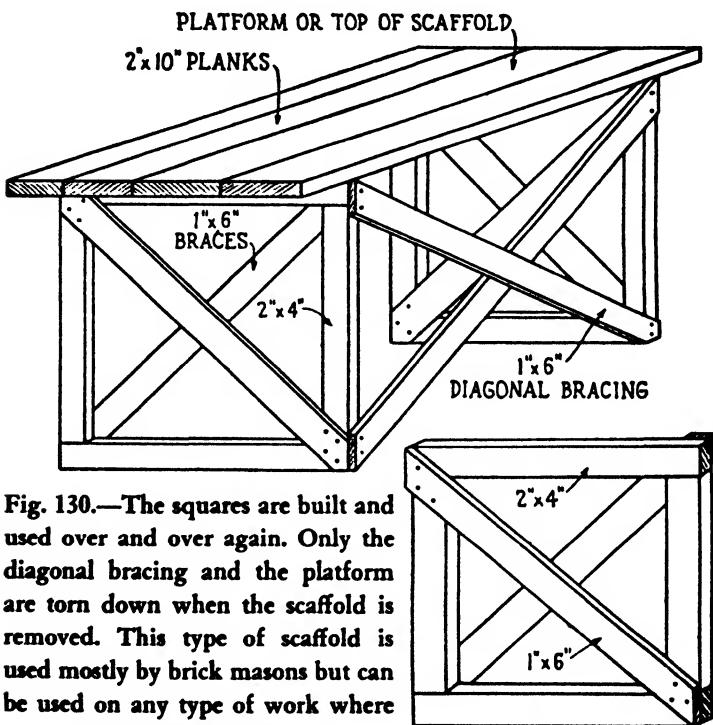


Fig. 130.—The squares are built and used over and over again. Only the diagonal bracing and the platform are torn down when the scaffold is removed. This type of scaffold is used mostly by brick masons but can be used on any type of work where platforms are needed.

SQUARES are used mostly by brick masons and are made 4 ft. 6 in. square. They are made from 2 by 4's and 1 by 6's (Fig. 130). As soon as the brick mason is above his foot scaffold, the squares are set up along the wall or work. Braces made of 1 by 6's or 1 by 8's should be nailed on diagonally. The entire top is then planked with a 2 by 10 for a working platform. When the second set of squares is set up for more height, all the 2 by 10 planks are removed except the two outside ones, which are left to hold up the second tier of squares and to help brace the entire scaffold.

How to make a safe chimney scaffold. When a chimney top is being constructed or repaired, a scaffold is needed that will not damage or injure the roof (Fig. 131). As the carpenter is called upon to do all such work, a great deal of time can be saved by using a scaffold as shown here.

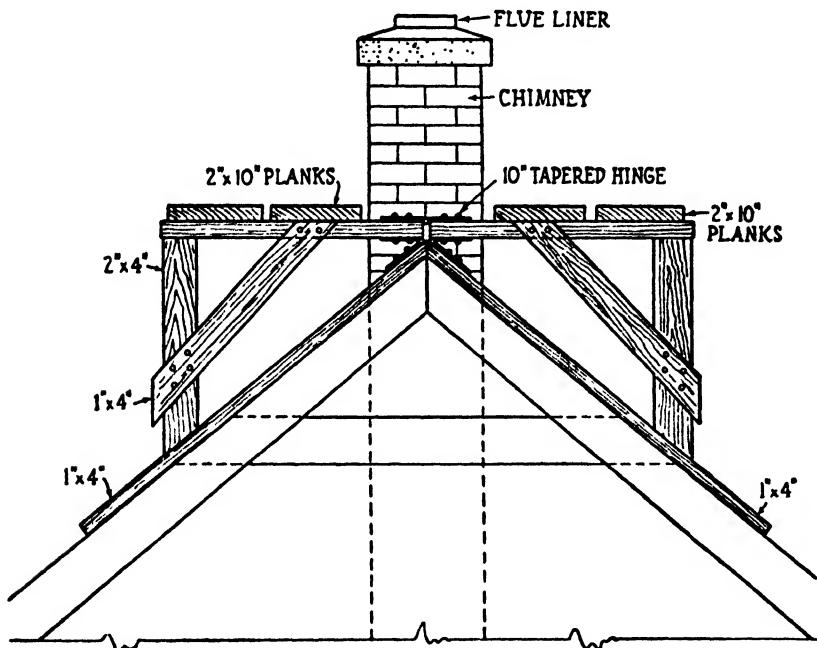


Fig. 131.—How to build a safe and portable chimney scaffold. This type of scaffold does not damage the roof and is very easy to move or dismantle.

1. Cut two 2 by 4's, each 3 ft. long.
2. Hinge those together at the top with an 8- or 10-in. taper hinge.
3. Cut two uprights of 2 by 4, 24 in. long.
4. Nail the 2 by 4's together at the corner and brace with 1 by 4's.
5. On the under side nail two 1- by 4-in. braces about 5 ft. long. The scaffold legs will rest on this and thus form a protection for the roof.
6. Build two sets of these and cover with 2 by 8's or 2 by 10's for walk boards.

SAFETY MEASURES IN THE BUILDING TRADES

“Seldom is a good mechanic injured.”

The first and most important factor in safety measures is the attitude of the worker himself toward safety. This is most necessary in reducing accidents in any work situation. The second factor is in knowing the correct and the safe way to handle or use all equipment. The best attitude comes only from a worker who has a deep interest in his job. A good attitude and a deep interest in his work are not sufficient unless tools, machinery, and equipment are also kept in first-class mechanical condition. For example, a dull circular-saw blade would be extremely dangerous to use regardless of how much interest a man had in his work, how much knowledge of safety he had, or how good his attitude was.

Hand tools should be kept in good condition at all times. Keep handles tight and never use broken tools for anything. Keep your stock and materials in order and floors clean at all times. This is most essential in the building trades. The most troublesome factor in causing accidents in the building trades is the inclination of workmen to be careless, not to keep their minds on their work, and to gamble with their lives just to save a few minutes of time. This is particularly true in building and using scaffolds.

Safety rules for the builder. The following are a few good rules for safety that the builder should always observe:

POWER MACHINERY

1. Never operate a power saw, sander, or any machine unless you have been instructed in its operation.
2. Never operate any machine without the safety guards in place.
3. Be sure that your machine is grounded. Stand on a wooden platform whenever possible while operating power machinery.
4. Use an extension of sufficient size and length to do your job with easy operation.
5. Do not walk or step on drop cords or extension cords.

6. Never use electric current on a job unless the circuit is properly fused and grounded.
7. Do not start your cut on a saw, whether portable or stationary, until the saw has picked up full speed.
8. Remove all nails from stock before cutting it on a power saw.
9. Lumber with cement, plaster, lime, etc., adhering to it should never be run through power machines.
10. While sawing off blocks, boards, and ends, watch below, that falling pieces do not hit another workman.

PERSONAL SAFETY

1. Always wear a pair of overalls or clothes specially designed for the work you are doing.
2. It is better not to wear rings, jewelry, loose-fitting clothing, or long neckties. They are likely to become caught in machinery, on nails, or on scaffolding.
3. Always conduct yourself in the best workmanlike manner. You are always judged by your actions.
4. Loud and unnecessary talking should be avoided.
5. Never attempt to work if you do not feel well. Climbing on roofs, scaffolds, etc., in this condition may cause dizziness.
6. Never attempt a job where scaffolds are needed unless a safe and sturdy one has been built.
7. Never carry sharp tools in your pockets. This includes open blades, chisels, dividers, etc.
8. Keep materials picked up from the floor or in places where you are working or where you have to walk or pass.
9. Do not work with a pencil in your mouth. Do not carry nails in your mouth.
10. Always put oily rags and waste in an iron container, or take them out and burn them. This will prevent spontaneous combustion and possible fires.
11. Keep your hands as clean as you can for the work you are doing.

12. Do not try to work on substitute scaffolds. Inverted boxes, barrels, nail kegs, etc., make poor platforms, ladders, or scaffolds.

GENERAL SAFETY PRACTICE

1. Always place a ladder on good sound footing. This prevents tipping or sliding to one side.

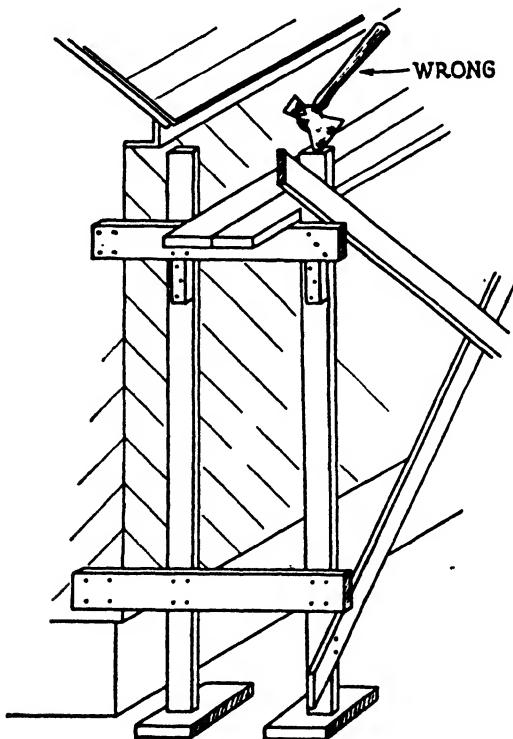


Fig. 132.—Never leave a hatchet, ax, or sharp tool of any kind stuck into a scaffold or any place where it might fall on a fellow workman.

2. Do not attempt to reach heights beyond the length of your ladder. *Get a longer one.*

3. When using ladder jacks, see that they are fastened securely in place.

4. Never use a ladder with a broken round in it. You will forget that it is missing and will fall.

5. Keep your hammer handles tight. A loose one will let the head fly off and hurt a fellow workman.

6. Always hold a nail until it is well started into the wood. A glancing blow might cause it to fly into someone's eye.

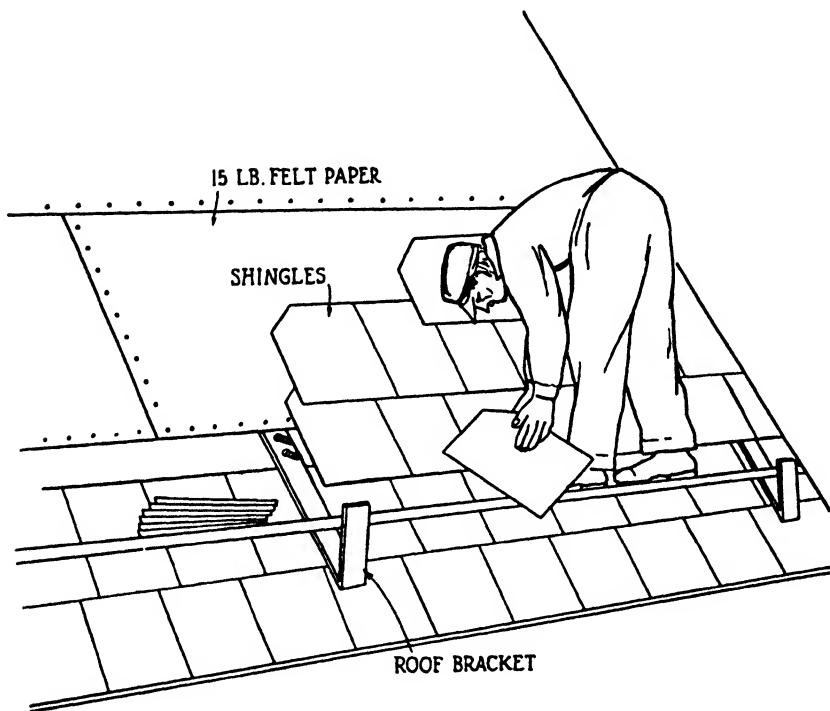


Fig. 133.—Always keep your eyes open and do not walk off the end of a scaffold or step off the edge of a roof.

7. Do not attempt to work on a roof or a scaffold when it is wet or has frost on it. You may slip and fall to the ground.

8. Never let tools or material slip or slide from a roof or scaffold. It will invariably fall on someone.

9. Never lay a hammer down. Always carry it in your hammer strap in your overalls.

10. Hatchets and axes should not be left where they will fall. They should never be stuck into the end of a scaffold or other places

(Fig. 132). Put them back into your toolbox after you have used them.

11. Do not attempt to carry or lift more than you can handle.



Fig. 134.—Do not attempt work of this type without sufficient protection. Use ladders, guards, roof brackets, or scaffolds where it is at all possible.

12. Always keep your eyes open and do not walk into an unguarded stair well, open hole, flue well, off the end of a scaffold, off the edge of the roof, or from any of the many places found during the construction of a house with little or no guarding. It is impossible to guard all of these at all times (Figs. 133, 134).

9

BLUEPRINTS AND SPECIFICATIONS

BLUEPRINTS

How to read blueprints. It is essential that students of building trades be able to do simple blueprint reading, that is, know how to interpret working drawings, or blueprints. To read a blueprint, one must be able to picture or visualize in his mind the object as it will appear after it is made or built. He must be able to get from the blueprints such information as shapes, sizes, methods of construction, locations of various parts, kinds of materials used, etc. He should be able to interpret all the symbols and notations concerning the job.

The building trades student should first remember that a blueprint is a *record of instructions* given to him. Second, he should realize that the language used by the draftsman in making his drawings is largely a language of lines and that, unless the student can read and understand these lines, the instructions on a blueprint are merely a foreign language.

When a set of house plans are to be read, one should first study the several views until he has a mental picture of what is to be constructed. As a blueprint is a flat surface, it is necessary for the

workman to use his imagination to make the lines and views lift up from the paper into their natural and intended planes.

Views. A drawing or plan usually represents a view of some one thing. Consider, for example, the house in Fig. 135. In your imagination see the view from several sides. If you stand directly out in front of the house and look directly at it, you will get the front view. You will note that this view appears as a flat wall. You do not



Fig. 135.—If you stand directly in front of the house and look directly at the front of it, you will see a "front view."

see any of the sides or the back of the house. This front view in house plans is usually called the *front elevation* (Fig. 136). It shows the height of the house, the style of windows, the kind of siding material, and the general shape.

If you stand out at the right side of the house and look directly at the end of it, you see an *end view* or *right side elevation*. If you stand on the left side and look directly at the end of it, you see another end view, the *left side elevation*. If you stand in the rear of the house and look directly at it, you see a *rear view*, or *rear elevation*.

Thus you have established: (1) the front elevation, (2) the right side elevation, (3) the left side elevation, (4) the rear elevation (Fig. 136). Sometimes these are expressed in terms of north, east, west, and south elevations. These, of course, are established only after a definite location for the house has been determined.

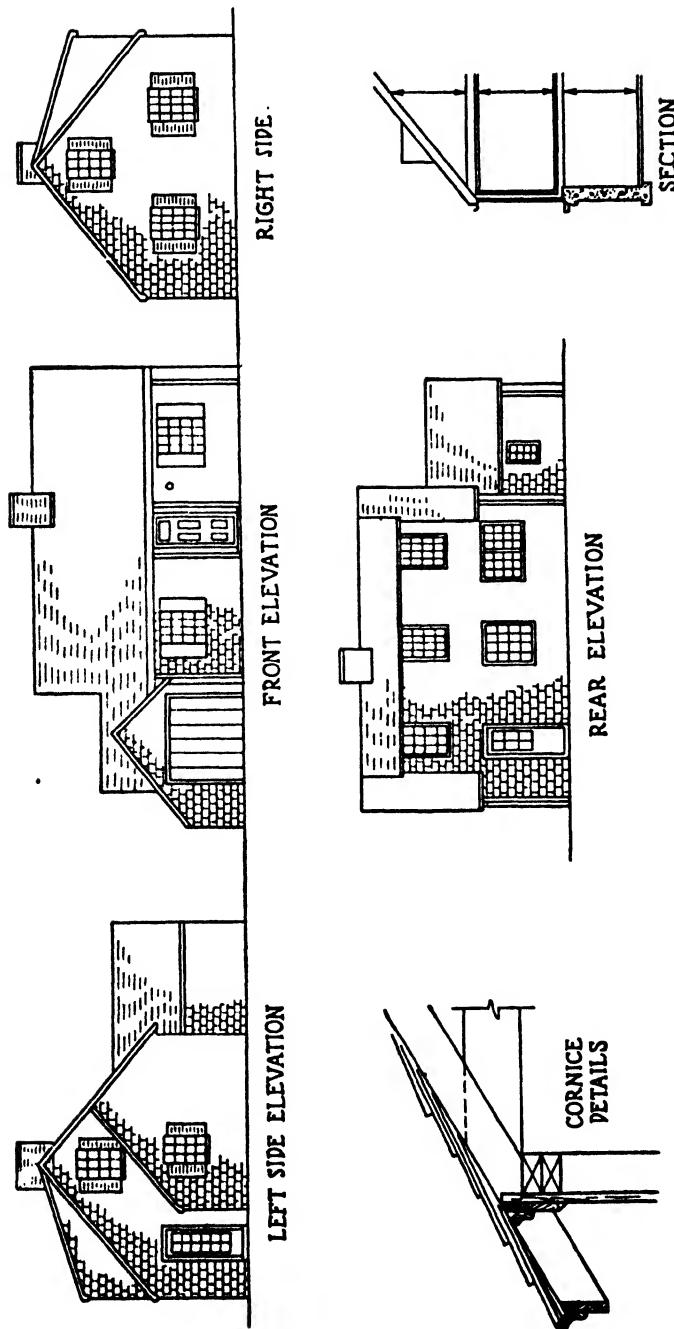


Fig. 136.

House plans. Ordinary house plans may be grouped as follows:

Plans:	Elevations:	Details:
Plot plan	Front elevation	Construction details
Basement plan	Right side elevation	Cabinet details
First-floor plan	Left side elevation	Finish details
Second-floor plan	Rear elevation	Architectural details
Roof plan	Sectional elevation	Material details

PLANS. Plans are views taken in the horizontal plane. For example, take a large sheet of glass and hold it directly over the top of the house. By so doing you establish a horizontal plane. If you look through this glass and draw upon its surface an outline of the top of the house and roof, you have drawn a top view or an outline of the *roof plan* in the *horizontal plane*.

Floor plans are drawn in the same manner except that they represent only a cross section of the house and are taken at about 3 ft. above each floor level. They are really top views of these cross sections (Fig. 137).

ELEVATIONS. Elevations are views taken in the vertical plane. For example, stand again directly in front of the house and hold a large sheet of glass in a vertical position. In doing this you establish a vertical plane. If you look through the glass and draw upon its surface an outline of the front of the house, you have drawn an outline of the *front elevation* in the *vertical plane*.

DETAILS. Details are drawings usually at a larger scale than the rest of the house, showing such things as construction, finish, and kinds of material. Figure 136 shows a cornice detail, because it would be difficult to show this feature in elevations.

SYMBOLS. Symbols are representations that have been more or less standardized to represent various items and methods of construction in their field. House plans, of course, would include symbols from all the divisions of the building trades, such as carpentry, plumbing, wiring, masonry, and many others. In order to interpret

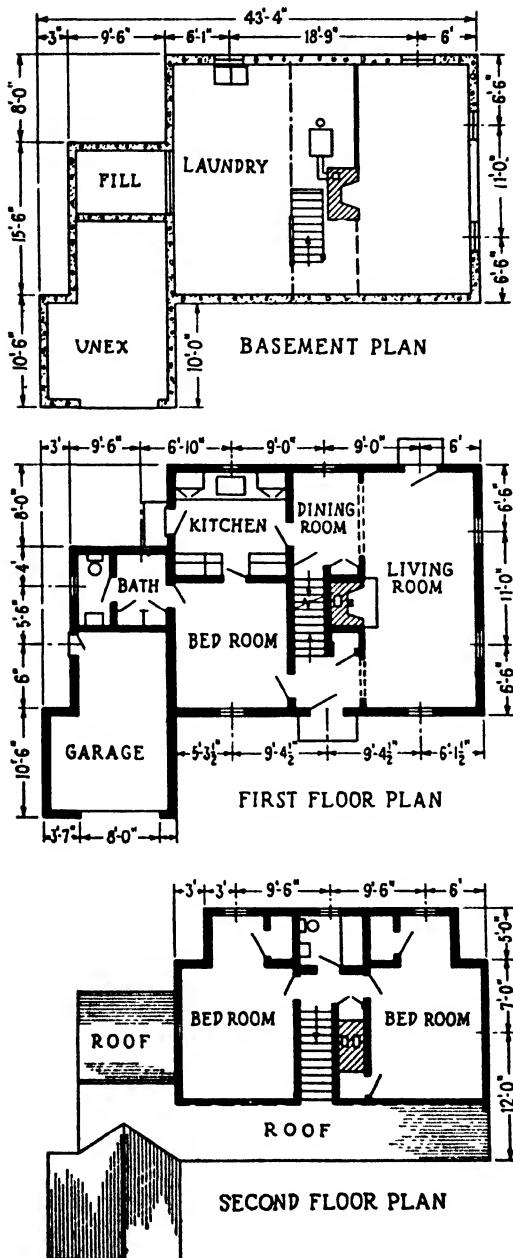


Fig. 137.

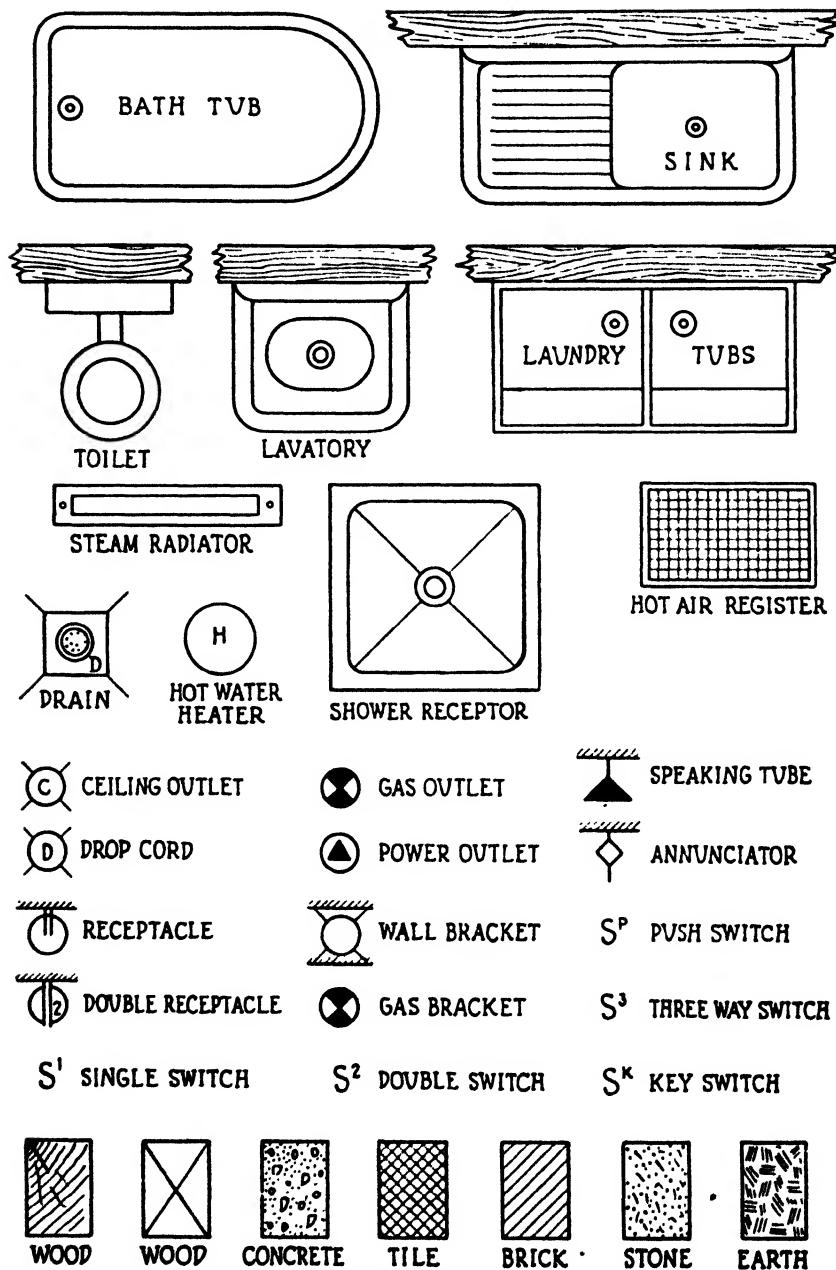
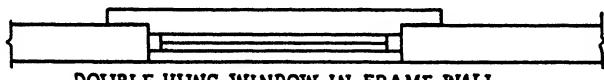
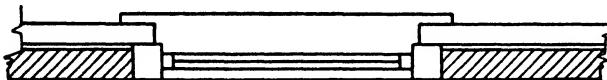


Fig. 138.

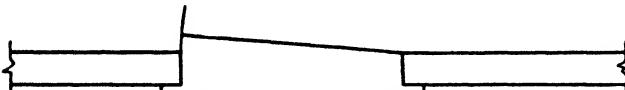
a drawing, one should be able to recognize the symbols found thereon. Some of the more common symbols are shown in Figs. 138 and 139.



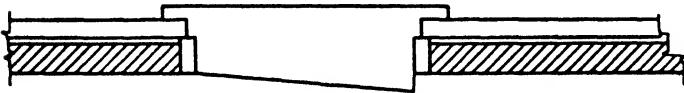
DOUBLE HUNG WINDOW IN FRAME WALL



DOUBLE HUNG WINDOW IN BRICK VENEER WALL



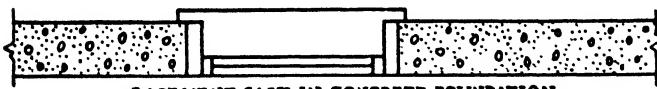
OUTSIDE DOOR FRAME IN OUTSIDE FRAME WALL



OUTSIDE DOOR FRAME IN BRICK VENEER WALL



INSIDE DOOR



BASEMENT SASH IN CONCRETE FOUNDATION

Fig. 139.

DIMENSIONS. Dimensions are lines, arrows, and figures used to indicate various sizes, positions, distances, etc., on the plans.

Interpretation. On the following pages will be found a complete set of plans and specifications for a small frame house. They are as follows:

- Figure 140. Plot plans and grades
- Figure 141. Basement plan
- Figure 142. First-floor plan
- Figure 143. Front elevation
- Figure 144. North elevation (right side)
- Figure 145. South elevation (left side)
- Figure 146. West elevation (rear)
- Figure 147. Details

From these plans determine the following:

General:

1. What is the type of house?
2. In which direction does it face?
3. How many stories are there?

Plot Plan:

1. What is the size of the lot?
2. Is the lot level?
3. How many feet of lawn are there on the north side of the house?

Basement Plan:

1. What is the foundation size over all?
2. How thick is the foundation?
3. What kind of material is used in the foundation wall?
4. How many basement windows are there in foundation?
5. What is the type of basement windows?
6. What size are the basement windows?
7. How many pier posts are in the basement?
8. What are their size and kind?
9. Give the size of the girders.
10. Give the size of the floor joists.
11. Is there a coal room?
12. If so, what is its size?
13. How many flues are there?
14. Give their size.
15. How many floor drains are shown?
16. By what scale is the plan drawn?

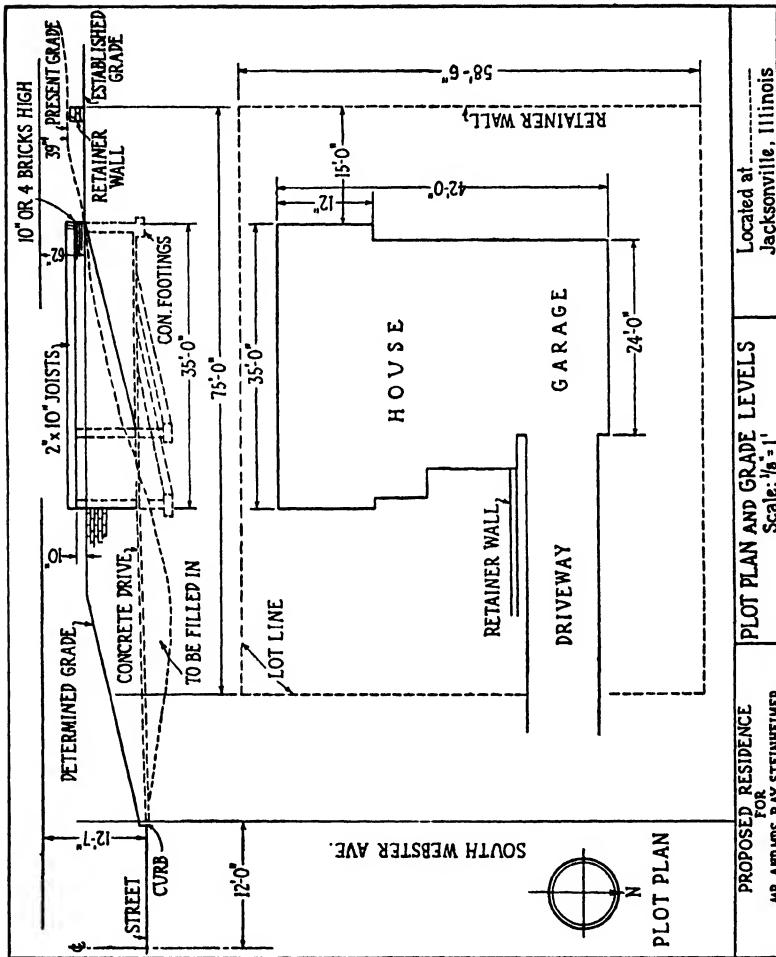


Fig. 140.

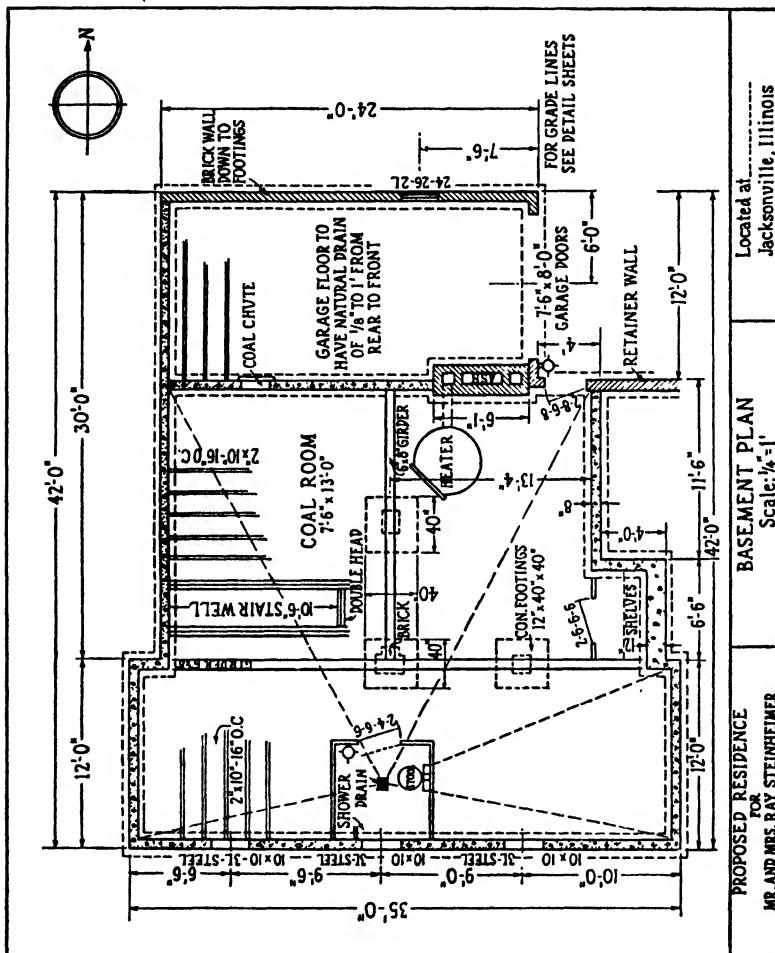


Fig. 141.

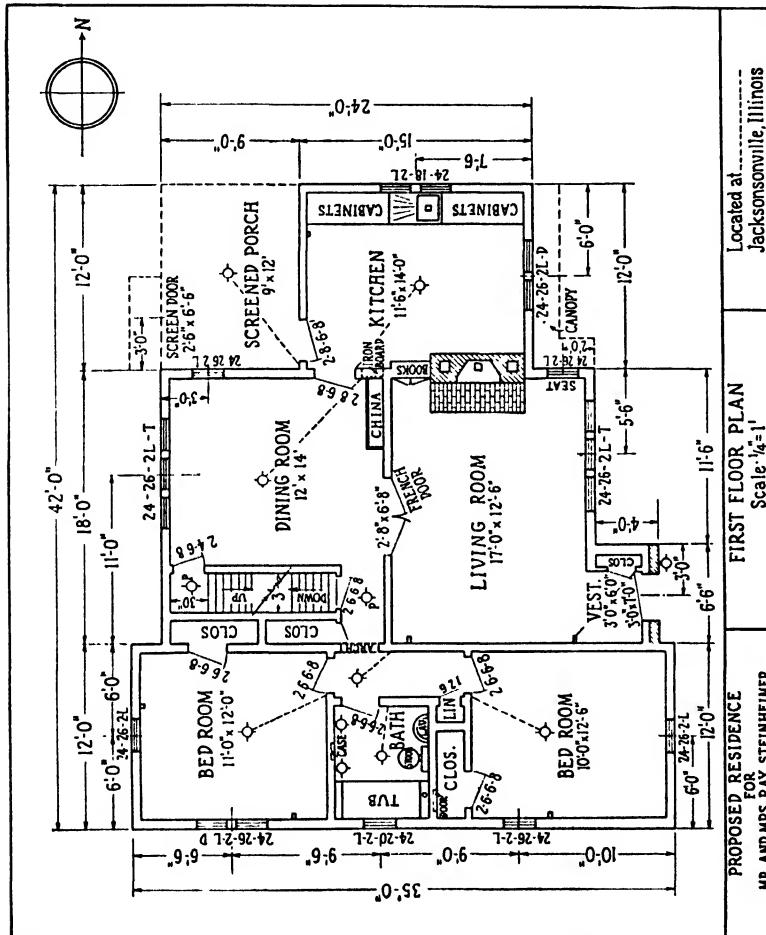


Fig. 142.

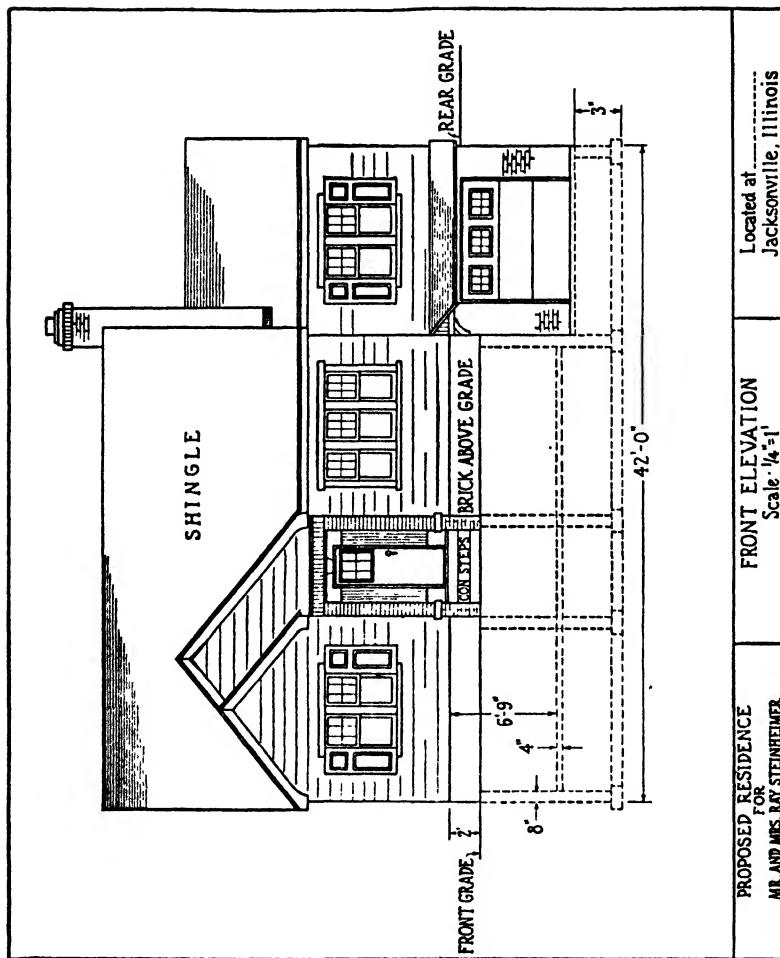


Fig. 143.

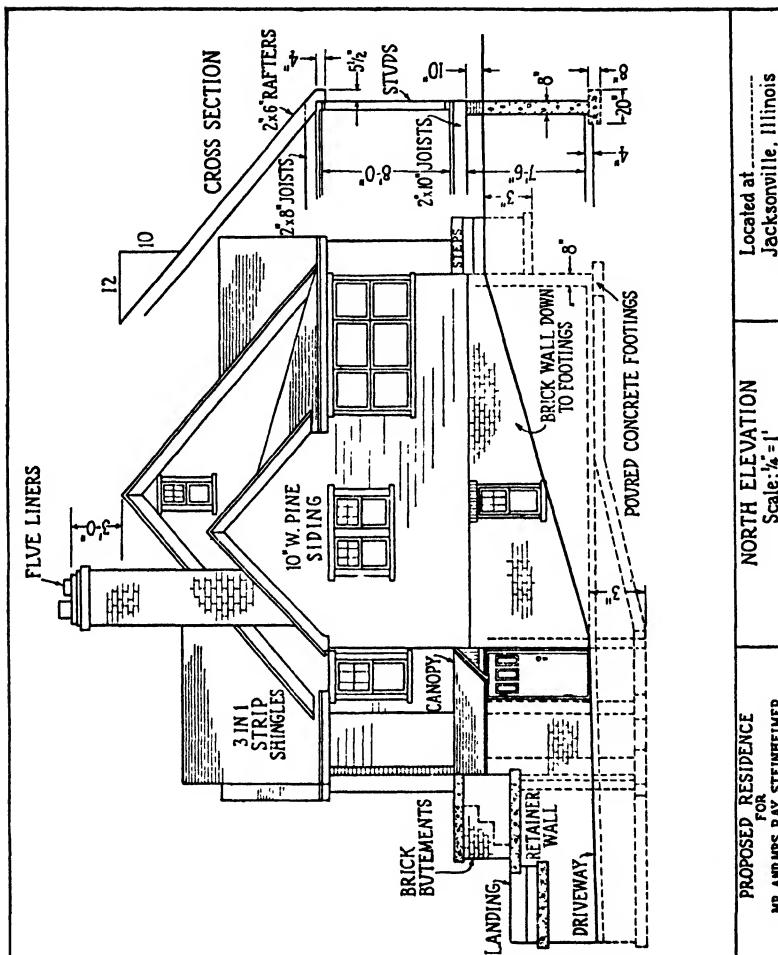


Fig. 144.

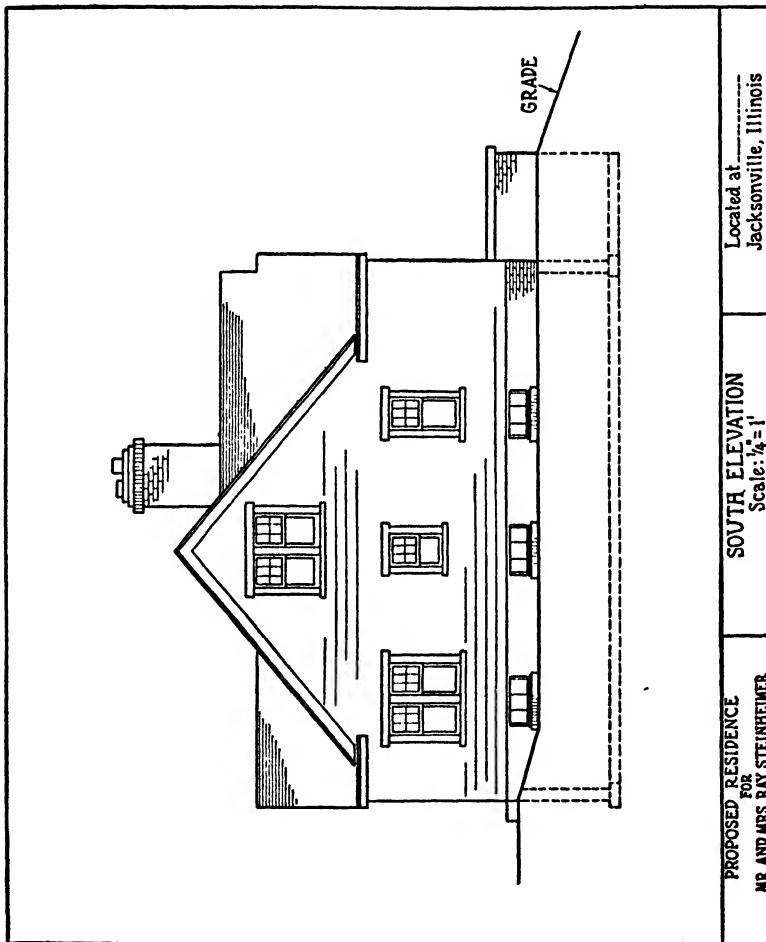


Fig. 145.

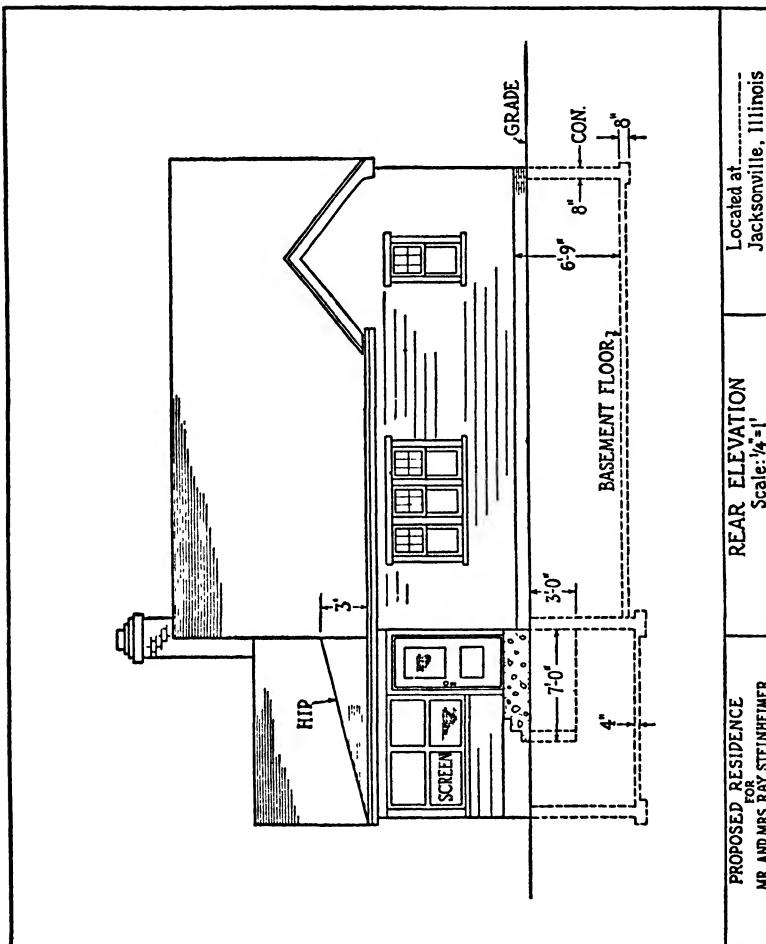


Fig. 146.

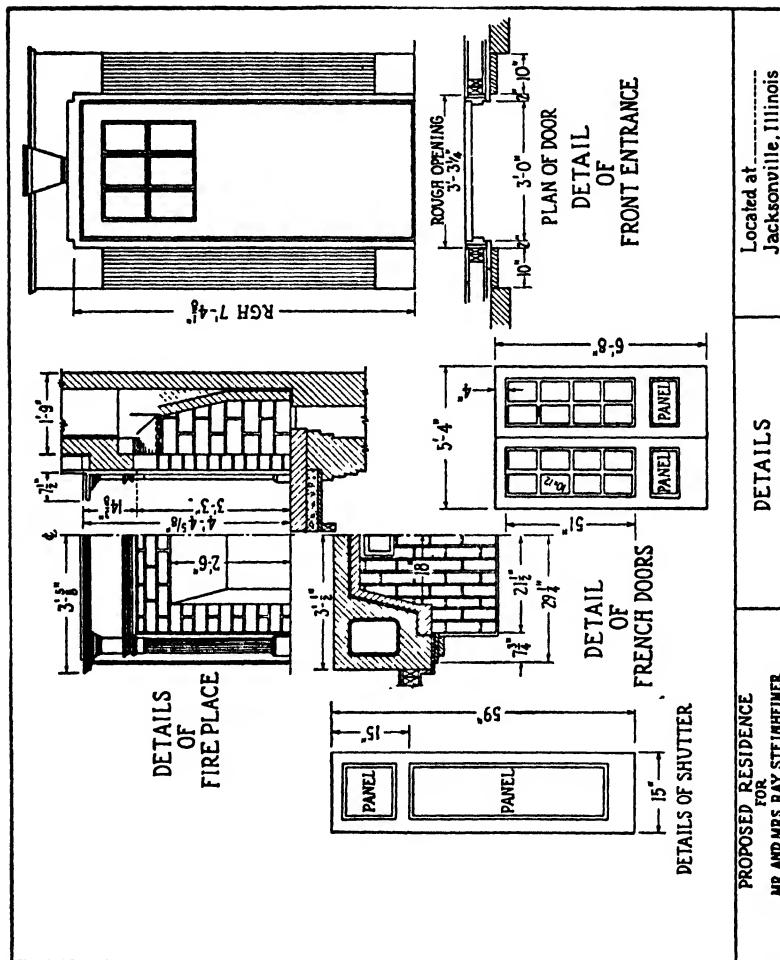


Fig. 147.

First-floor Plan:

1. How many rooms are shown?
2. Name each room and give its size.
3. What kind of walls is indicated?
4. How many single windows are there?
5. How many double windows are there?
6. How many triple windows are there?
7. What is the size of the bathroom window?
8. What is the size of the kitchen window?
9. What is the size of all other singles?
10. What fixtures are found in the bathroom?
11. Name the built-in fixtures shown.
12. Are there stairs up or down, or both?
13. What size treads and risers are shown?
14. What type of back porch is shown?
15. How many inside doors are needed? Give their size.
16. How many exterior doors are needed? Give their size.
17. How many ceiling outlets are shown?
18. How many base receptacles are shown?

Front Elevation:

1. What is the total distance across the front of house?
2. How thick is the basement floor?
3. What kind of siding is used on the house?
4. How many shutters are used?
5. What kind of steps is used?
6. What kind of roof shingles is used?
7. What type of garage doors is used?
8. What is the depth of the basement?

North Elevation:

1. What size rafters are used?
2. The ceiling joists are what size?
3. How wide and how thick are the wall footings?
4. What size of attic window is used?
5. What kind of foundation is used above the grade line?
6. How thick is the garage floor?
7. What kind of flue is shown? How wide is it?

8. Where are soldier courses of brick used?
9. What is the pitch of the roof?
10. How high are the ceilings of the first floor?
11. What is the brick retainer wall for?
12. What is the canopy for?

South Elevation:

1. What is the length of the building on this side?
2. How many basement sash are shown?
3. What size are they?

West Elevation:

1. Over what room is the hip roof used?
2. Give the size of the screen frames used on the back porch.
3. What kind of steps is shown in this elevation?
4. How many risers are shown?
5. How many treads are shown?

Details:

1. What are the sizes of each French door?
2. What are the sizes of each shutter?
3. What is meant by rough opening?
4. Give the width of the mantel.
5. Give the height of the mantel.
6. What is the size of the fireplace opening?

SPECIFICATIONS

Almost all house plans are accompanied by a set of specifications. These are *statements of particulars* which tell you what you are going to receive in materials and workmanship for the construction of your house.

The following specifications are for the house described in the accompanying figures and are characteristic of small frame-house specifications.

SPECIFICATIONS

For the construction of a house for

NAME _____

1. Excavation. The basement is to be staked out and excavated square and true. Excavation shall be under the entire house as shown on the plans, and shall include excavation for all footings. All dirt is to be left on the lot for grading purposes. Contractor is to do all rough grading. Excavation shall be deep enough to permit 6 ft. and 9 in. from finished floor to floor joists (see plans).

2. Concrete work. All concrete used in floors, walls, footings, steps, caps, etc., shall be of a 5-2-1 mixture, properly mixed with a concrete mixer. All walls shall be properly spaded to make a smooth wall and surface. All outside basement walls shall be concrete 8 in. thick as shown on the plans, except for the front wall under the front entrance, which shall be 12 in. thick as shown on the plans. All footings for piers and walls shall be 8 in. thick and of size as shown. The basement shall be concreted over the entire area with 4 in. of concrete. Basement floor shall be topped with $\frac{3}{4}$ in. concrete mixture of 2-1 sand and cement, and finished in good workmanlike manner, properly graded to a cast-iron drain as shown. All sidewalks shall be of the same construction as the concrete floor, with steps, etc., as shown on the attached plot plan for walks. Back steps and front steps shall be of the same construction as the basement walls and floors. The front steps shall be of concrete of straight steps as shown on plans. All sills are to be bolted down to foundation walls with $\frac{1}{2}$ by 8-in. bolts. A concrete driveway shall be built from the garage to a distance of 44 ft. from same, be 12 ft. wide, and located as shown on the plot plan. This shall include a culvert to be built at the street and located properly for correct drainage. The garage floor and the driveway shall be reinforced with a good grade of heavy reinforcing mesh. Also proper expansion joints shall be located at intervals of about 15 ft. All driveway and walks shall be laid over at least 3 in. of cinders or other approved base as required by the Federal Housing Administration. Forms shall be provided on both sides of concrete foundation walls, except where soil conditions are such that exterior forms can be omitted without impairing the strength of the concrete or the minimum

thickness of the wall. A splash wall shall be built around the shower room, except at the doorway and back wall, 12 in. high and 6 in. thick.

All aggregate shall be of a good grade of clean *washed* sand and gravel.

The contractor shall furnish all material for the construction of necessary forms, runways, etc.

3. Brickwork. All brickwork shall be as shown on the plans. A base figure of \$35 per thousand shall be used on all face brick, and a base figure of \$20 per thousand shall be used on all common brick. This will permit the use of good, sound, used common brick.

All brick below the grade line shall be laid up in portland cement mortar mixed according to FHA requirements. All brickwork shall be started on concrete footings or walls as shown on the plans. All brick above the grade and not exposed to earth shall be laid up in colored mortar, not natural, except that used in the construction of the flue and other parts not exposed to view. The retainer wall shall be approximately 13 in. thick and well anchored with iron rods of sufficient size to hold wall in place.

4. Flue. The flue shall be laid up from the flue footings of common bricks, except that part which is exposed to view above the roof. This shall be of face brick, the same as used for foundation walls and retainer walls and also laid in white mortar. The common bricks will be laid in common mortar. The entire flues shall be lined with flue liners throughout, with exposed portions at top of flue as shown on the plans. There shall be a clean-out door from ashpit opening into the garage, and one from the furnace flue opening into the garage.

5. Fireplace. The fireplace shall be built as shown on the plans, with mantel of face brick same as foundation and laid up in white mortar. Same to have ash dump and damper of good quality and proper size. The hearth to be of brick laid over concrete. The hearth brick to be selected by the owner.

6. Framework. All first-floor joists to be No. 1 grade yellow pine, 2 by 10, and spaced 16 in. O.C., and properly bridged and nailed to joists at each end. All second-floor and ceiling joists to be No. 1 grade yellow pine 2 by 8, spaced 16 in. O.C., and bridged if attic is to be floored and used as habitable.

All rafters shall be No. 1 yellow pine, 2 by 6, spaced 16 in. O.C. All rafters shall be reasonably straight, and every second one shall be tied with collar beams, size 1 by 6 as shown on plans.

All studding shall be No. 1 yellow pine 2 by 4, spaced 16 in. O.C., with all partition posts of three timber strength, a single plate at the bottom and a double plate at the top, of each wall. All boxing and sheathing and subfloors shall be No. 1 common grade yellow pine, 1 by 10, and shall have three nails for each timber.

Subflooring on first floor shall be laid diagonally, and all joints made over joists. There shall be placed grounds for all inside finish.

7. Floors. There shall be hardwood floors throughout the entire first floor. Same shall be $1\frac{3}{16}$ - by $2\frac{1}{4}$ - in. clear red, short lengths, properly laid and sanded to receive finish.

Between rough floors and finish floors there shall be placed a layer of asphalt-saturated waterproof building paper. All outside walls shall be covered with asphalt-saturated waterproof building paper between the boxing and the brick. Place shelves for fruit in basement as shown on the plans.

8. Roofing. The sheathing boards shall be laid tight, and the roof covered with a good grade of plain color slate-surfaced asphalt shingle, $12\frac{1}{2}$ by 36. Three-in-one shingles to be laid over a good grade of heavy felt No. 15 paper. Color of shingles to be selected by the owner.

9. Millwork and trim. All millwork shall consist of the following:

- 1 set of cabinets in the kitchen as shown on the plans and designed by the owner
- 1 built-in china closet
- 1 built-in bookcase
- 1 telephone shelf and box for book and bells
- 1 window seat
- 1 front-door entrance (for brick veneer)
- 1 ironing board
- 1 fireplace mantel
- 6 shutters for front as shown on plans.

All windows shall be properly fitted and adjusted for easy operation. All windows shall be of sizes as specified on plans and shall be primed when set. Same to be good grade white pine. All window frames shall be of a good grade white pine of sizes specified on the plans and primed when set.

All basement sash shall be of steel frames, 10 by 16, and fitted with three lights, installed as shown on the plans.

All outside trim shall be of good grade white pine. The outside front door shall be of good quality white pine $1\frac{3}{4}$ in. thick and of similar design to that shown on the plans. The grade entrance door at the garage shall be of same quality and of design as shown. The garage door shall be the overhead type with upper glass 6 light each of design as shown on plans. (Solid, not folding.)

All inside doors shall be of single-panel fir with white pine stiles and rails, $1\frac{3}{8}$ in. thick. All inside woodwork shall be of good grade yellow pine trim of design similar to B. W., 3442 C and J. Back band and trim base to be 1 by 6 in. with no molding. Bathroom to have a dado 1 in. wide around, 4 ft. high.

The stairway to the attic shall be built in only in the rough, with open treads and risers. The landing at the foot of the stairs shall be equipped with shelf and hook strip for use also as a clothes closet.

An area of about 10 by 20 ft. of attic space shall be floored with common 1 by 10 at the head of the stairs for storage space. Stairway to the basement shall be as shown on the plans, with a handrail down one side.

There shall be one recessed yellow pine telephone cabinet installed where owner directs as above mentioned.

There shall be installed one medicine cabinet in the bathroom, same to be supplied by the contractor.

10. Coalbin. A coalbin shall be built in the basement as shown on the plans of 1 by 10 shiplap extending from the floor to the ceiling. The coalbin door shall be about 24 in. wide. A heavy steel coal-chute door shall be installed in the basement wall as shown in the basement plan.

11. Shower enclosure. A shower enclosure shall be built in the basement as shown on the plans, type of wall material to be selected by the owner.

12. Hardware. All rough hardware shall be furnished by the contractor. For all finish hardware such as locks, hinges, knockers, etc., a base figure of \$70 shall be used. There shall be installed for each door a bumper and stop; and for all windows, locks, and lifts. All hardware to be a lemon brass finish—such as, locks, half-surface hinges, etc.

13. Plastering. Lath and plaster on the entire interior including all closets, stairways, etc. All walls adjacent to unheated spaces shall be covered with celotex lath, and all walls and ceilings adjacent to heated spaces shall be covered with rock lath.

All door openings and bases shall be properly grounded. All inside corners of rooms shall be stripped with metal corner lath, and all outside corners and edges in rooms shall be stripped with metal corner bead.

All plaster shall be Acme or equal, properly mixed and applied. The finish coat shall be white coat. The bathroom shall be plastered with Keen's cement up to the dado, 4 ft. high, and marked off in tile effect. The rest of the bathroom to be finished in white coat.

14. Painting. All outside woodwork, downfalls, metal work, guttering, inside of garage doors, etc., screens for back porch, and all window screens to receive three coats of pure Dutch Boy lead and oil paint.

All metal work to receive priming coat of red lead metal paint and two coats of white lead paint.

All outside colors to be selected by the owner.

All weatherboarding shall have one priming coat of white lead and oil paint on the *back side before being nailed* in place.

All window glass to be left clean and free from paint by painter.

15. Painting inside. All inside woodwork to be finished in walnut stain and varnished, and shall consist of the following: 1 coat stain, 1 coat white shellac, and 2 coats varnish, each coat to be rubbed down before succeeding coat is applied.

16. Floors. All hardwood floors to be completely finished ready for use as follows: 1 coat of light natural-wood filler, 2 coats of white shellac, each coat cut 50-50 shellac and solax, and each coat rubbed down with steel wool, and two coats of floor wax applied and each coat polished.

All the above work to be done in a good workmanlike manner by a workman of the trade.

17. Screens. There shall be made and installed screens for all outside windows, including all basement screens and back porch screens. Same to be covered with No. 16 mesh galvanized screen wire. All screen frames shall be constructed of white pine $1\frac{1}{8}$ in. thick with metal corner fasteners. At the front and rear entrance there shall be installed a combination summer and winter screen door. (Removable screen and glass panels.) Back porch to receive ordinary light-frame screen door.

18. Guttering. Provide 5-in. eaves troughs and 4-in. corrugated downfalls or conductor pipes with all necessary hooks, hangers, elbows, shoes, outlets, etc., all to be of good grade, 26-gauge galvanized metal, with copper strainers at every outlet. All to be properly formed, soldered, and

installed complete to take care of the water from the entire house and porch.

19. Wiring. The house shall be completely wired as shown on the plans. All ceiling outlets shall be on single wall switches, except two basement outlets which shall be three ways as shown on the plans. One switch for this three way will be at the head of the basement stairs, and the other at the grade entrance door inside. There shall be one outlet in the attic near the head of the stairs with a switch at the foot of the stairs. There shall be one outlet, ceiling at the foot of the stairs, pull-chain type. There shall be one outlet at front entrance outside and one similar at grade entrance outside. Each bedroom shall have one ceiling outlet and two base receptacles. The bathroom shall have one ceiling outlet, two wall outlets, and one base receptacle. First floor shall have one ceiling outlet. The living room shall have four base receptacles only. The dining room shall have one ceiling outlet and two base receptacles. The kitchen shall have two ceiling outlets and three base receptacles. Each closet in each bedroom shall have one pull-chain ceiling outlet. The basement shall have four outlets, one of which is on a three way, above-mentioned. The back porch is to have one ceiling outlet and one base receptacle.

All wiring shall be done in B.X., according to local building code standards and FHA requirements. All switches shall be the tumbler type with bakelite plates.

The electrical contractor will furnish all fixtures and hang the same ready for use. A base figure of \$65 will be used to furnish fixtures, the owner to select same.

20. Heating. There shall be installed in the basement one 26-in. steel furnace, hot air, complete and ready for use. The furnace shall be of good quality, heavyweight steel, installed with proper hot-air capacity and proper cold-air capacity with all necessary heat pipes, etc., to ensure a good first-class job in every respect and ready for use. Furnace to be fully equipped with blower unit for forced air and filters.

Cold- and hot-air registers to have finish selected by owner. All registers to be of the wall type. All heat and cold-air pipes to be the square type.

There shall be installed one heat pipe to the shower room. There shall be installed two heat pipes to the attic; same not to be connected to furnace at present, but proper space for same to be left on furnace hood for future use.

All equipment to be new and of standard stock and shall be installed by workmen of the furnace trade. The heating system shall be of such capacity that under normal conditions and normal operations it will produce and maintain a temperature of not less than 75 degrees in habitable rooms, with outside temperature at zero.

21. Plumbing. The plumbing shall consist of the following: There shall be installed in the kitchen under the double windows one double drain sink, style and size to be selected by the owner. Install in the bathroom one built-in tub, one lavatory basin, and one stool. Install in the basement in the shower room one lavatory basin and one stool.

All of the above to be fitted with chromium-plated fittings properly fitted and adjusted. The above fittings and fixtures shall be selected by the owner, and a base figure of \$100 shall be allowed. All of the above shall be properly installed and connected to both hot and cold water and necessary drains to sewers. Also install in the basement one faucet for hot and one faucet for cold water. There shall be installed in the basement a 30-gal. range boiler with coil in furnace connected with hot- and cold-water lines, to gas heater, and to a coal heater ready for use.

All soil and vent pipes to be 4-in. cast iron and to extend 5 ft. outside the foundation walls. Soil pipe to connect to 6-in. bell tile, tile to run for a distance of 15 ft. from house and to connect to a septic tank. There shall be a 4-in. tile leading from septic tank to a distance of 75 ft. and shall empty into a gravel pit.

All plumbing connections to be made to this disposal complete and ready for use. Cast-iron floor drains in basement shall be installed and proper connections made for same. Install one sill cock on outside foundation on east side of house.

The plumber shall make all city water connections, furnish water meter and necessary shut-off valves inside and out of foundation, secure all permits, etc., of every nature to make a complete and satisfactory job of plumbing ready for use by the owner.

22. General. These plans and specifications are to be considered as one and are to be used as such. Items in specifications are to be followed regardless or not of their appearance in plans. Items on plans are to be followed regardless or not of their appearance in specifications.

Complete agreements should be made between owner, contractor, architect, and subcontractors, as to kinds, quality, prices, etc., on any changes that are to be made after a contract has been once made.

The contractor shall take all necessary precaution to protect the building, plaster, etc., by closing the windows and openings at night or other times when necessary.

All work shall be done in a first-class manner, straight, plumb, true, level, and square.

23. Insurance. The contractor shall carry compensation insurance as specified in the Workmen's Compensation Act for the state of (or in states where this is a law).

The owner shall carry complete and sufficient amount of windstorm, cyclone, tornado, hail, water, and fire insurance throughout the construction of the building to cover any loss by such incurred during the construction.

24. Bids. The owner reserves the right to accept or reject any or all bids.

10

PROJECTS, QUESTIONS, AND PROBLEMS

SUGGESTED PROJECTS

Many of the operations listed above cannot be taught successfully except on an actual building project. For this reason special effort should be exerted to secure this type of work for the building trades classes. Each boy should have a year's experience on a building if possible.

However, many of the above operations *can* be taught without a house or any building to construct. Following are a few suggested methods and projects for doing this:

1. The laying out and cutting of rafters can be taught on short pieces of 2 by 4's. The lines can be planed off later, and the same pieces used over again.
2. Framework may be taught by constructing small-scale frames from stock that has been scaled down to $\frac{1}{4}$ or $\frac{1}{8}$ in. in size.
3. Window and door frames may be made to scale and taken apart to be used again.
4. Repair work on small buildings and garages also offers an opportunity for teaching the above operations.

5. Much valuable information can be gained from observation. Visit a house under construction and observe the actual work in progress.

6. Building projects such as the following will aid in teaching technical information, tool processes, and simple forms of construction not generally found in frame construction:

- a.* Sawhorses
- b.* Trellises
- c.* Workbenches
- d.* Hog feeders
- e.* Hog houses
- f.* Flower boxes
- g.* Fences
- h.* Gates
- i.* Garden furniture
- j.* Window screens
- k.* Door screens
- l.* Repair work

However, such work as plumbing a wall, bracing a house frame, setting window frames, door frames, and jambs, or fitting window sash can be taught only on an actual construction job.

QUESTIONS AND PROBLEMS

1. What tools are necessary for the building trades students to have and to use?
2. Name six common joints used in framing today.
3. Name three general types of framing and list their characteristics.
4. What are wall footings?
5. How is the length of a bearing post determined?
6. What is the purpose of foundation sills?
7. How are built-up girders generally made?
8. Describe the purpose of floor joists. How are they spaced?
9. Where are joist headers used?
10. What is a trimmer and where is it used?

11. Why are ceiling joists usually placed 16 in. on center?
12. Give five purposes of subflooring.
13. In what type of construction are floor plates used?
14. Where are double wall plates used?
15. What are studs and where are they used?
16. Show with a sketch how corner posts are made up.
17. Where are window headers used?
18. Why is it necessary to truss over wide openings?
19. What are the common sizes of wall sheathing?
20. Why is building paper so essential to good building?
21. Give the names of four kinds of felt and their weights.
22. What are rafters?
23. What determines the size of rafters?
24. How are rafters generally spaced?
25. What is meant by the term "rafter thrust"?
26. What are the four types of roof framing?
27. What is meant by the following terms: span, run, rise, pitch?
28. Give the rule for finding the rise of a roof.
29. Give the rule for finding the pitch of a roof.
30. List the principal roof pitches.
31. What does "length per foot of run" mean?
32. Give the rule for finding the number of inches rise per foot of run.
33. Name four kinds of rafters.
34. Describe the following terms: top cut, seat cut, length of rafter.
35. How do you find the length of a common rafter?
36. Lay out and cut a given top and bottom cut.
37. Why is it necessary to deduct for the ridge?
38. Describe the method for finding the length of hip and valley rafters.
39. How are side cuts obtained?
40. What are jack rafters?
41. Describe the methods used for finding the length of jacks.
42. How do you find the side cuts for jacks?
43. What is the length of a common rafter whose span is 24 ft., rise 8 ft., pitch $\frac{1}{8}$?
44. What is the length of a common rafter, span 24 ft., rise 12 ft.?
45. What is the length of a common rafter, span 20 ft., pitch $\frac{1}{8}$?
46. What is the length of a common rafter, run 12 ft., rise 8 ft.?
47. What is the length of a hip rafter, span 24 ft., rise 12 ft., pitch $\frac{1}{2}$?

48. What is the length of a hip rafter, run 14 ft., pitch $\frac{1}{3}$?
49. What is the length of a first jack on a roof, span 24 ft., pitch $\frac{1}{3}$?
50. What is the length of the second jack? The length of the third and the fourth?
51. How many common, how many hip, how many jack rafters are needed for a building with a hip roof, size of building 16 ft. wide, 24 ft. long? Give the length of each rafter.
52. What is the purpose of wood shingles?
53. In what sizes are wood shingles manufactured?
54. Name three kinds of roof shingles and give their sizes.
55. Describe the correct method for laying on roll roofing.
56. What is meant by the term "square of roofing"?
57. How is the amount of roofing determined for a shed-type roof?
58. How is the amount of roofing determined for a gable roof?
59. How is the amount determined for a hip roof?
60. How many squares of shingles will be needed for a shed roof, run 12 ft., length of building 20 ft., and pitch $\frac{1}{4}$?
61. Where are wall shingles used?
62. Name three kinds of wall shingles.
63. Name two general kinds of wall siding.
64. What are corner boards?
65. What are metal siding corners?
66. For what purpose are plaster grounds used?
67. Why is it necessary to mark stud positions before plastering?
68. Name three general kinds of laths.
69. Where is corner bead used? Give its purposes.
70. What do we mean by "inside finish"?
71. Name seven kinds of inside finish.
72. How is flooring classified?
73. What is meant by the term "quartersawed lumber"?
74. What is meant by the term "slash-sawed lumber"?
75. Name the parts of the cornices.
76. Name the parts of a house that usually make up the "outside finish."
77. What are stairs?
78. What is meant by "treads" and "risers"?
79. Give the first steps used in constructing any stairs.
80. How do we determine the number of treads and risers needed?
81. Where are dormer windows used?

82. What are check rail windows?
83. How are sash classified?
84. How should window sash be fitted?
85. Describe the three grades of window glass.
86. How is glass manufactured?
87. Give the correct procedure for glazing a glass.
88. What is putty? How is it made?
89. Describe five general types of doors.
90. In what manner are doors graded?
91. Give the eight steps used in fitting a door.
92. Describe how to hang and hinge a door.
93. What is the purpose of insulation?
94. How may heat losses be prevented?
95. List as many different kinds of insulation as you can.
96. Describe yard lumber.
97. List the common defects and blemishes usually found in wood.
98. What is meant by the following terms: board feet, linear feet, rough stock, dressed lumber, S. 2 S., S. 4 S., surfaced, jointed lumber, lumber, timber, planks, boards, strips, scantlings, and standard lengths?
99. Give the rule for finding the number of board feet in a piece.
100. How many board feet of lumber in a piece, 1 in. thick, 12 in. wide, and 5 ft. long?
101. How many board feet in a piece, 1½ in. thick, 11 in. wide, and 16 ft. long?
102. A piece 10 ft. long, 2 in. thick, and 11 in. wide contains how many board feet of lumber?
103. How many board feet in a piece 2 in. thick, 8 in. wide, and 14 ft. long?
104. How many board feet of lumber in the following: 124 pieces, 2 in. thick, 10 in. wide, and 16 ft. long.
105. Name two types of scaffolds.
106. Describe the essentials of good scaffolding.
107. Describe suspended scaffolds.
108. Describe fixed scaffolds.
109. Describe horse scaffolds.
110. Where are rolling scaffolds used?
111. What are safety laws?

112. List 10 safety precautions that all carpenters should employ at all times.
113. Why is it so essential to be able to read blueprints?
114. What are views?
115. How is a view obtained?
116. What is meant by a front view?
117. What are elevations on a house plan?
118. How are elevations obtained?
119. What is the difference between a plan and an elevation?
120. Name the three general groups into which house plans may be divided.
121. What is the purpose of a plot plan?
122. Why is a roof or framing plan necessary?
123. Details serve what purpose in a set of house plans?
124. What is meant by cabinet details?
125. Why are symbols necessary in a set of house plans?
126. Indicate with a sketch the symbols for the following: wood, concrete, tile, brick, stone, earth.
127. What are the dimensions on a set of plans?
128. What are specifications and for what purpose are they?
129. What are the advantages to the contractor in using specifications?
130. What are the advantages to the home builder?

LIST OF VISUAL AIDS

The following list of visual aids may be used to supplement some of the material in this book. It is suggested that each film and filmstrip be previewed before using as some may contain information that is too elementary while others may be too advanced.

These films and filmstrips may be obtained from the producer or distributor listed with each title. (The addresses of these producers and distributors are given at the end of this listing.) In many cases these films can be obtained from your local film library or local film distributor; also, many universities have large film libraries from which films can be borrowed.

The running time (min), whether it is silent (si) or sound (sd), motion picture (MP) or filmstrip (FS) are listed with each title. All those not listed as color (C) are black and white. All of the motion pictures are 16mm; filmstrips are 35mm.

All of the U. S. Office of Education motion pictures have coordinated silent filmstrips and instructor's manuals. In many cases other films also have instructor's manuals.

Each film has been listed only once in connection with the section to which it is most applicable. However, many of the films can be used advantageously in connection with other sections.

1. FRAMING

WOODWORKING TOOLS AND MACHINES (JH 14FS). Describes the various types of woodworking tools and machines.

ABC OF HAND TOOLS (GM 40min sd C MP). Shows proper use of simple tools.

SAFE USE OF TOOLS (Coronet 6min sd C MP). Shows the safe use of

such simple tools as scissors, knives, hammers, saws, files, clamps, and other small tools.

USE AND CARE OF HAND FILES (JH 20min sd MP). Depicts types and parts, correct positions, and movements.

HAND SAWING (JH 20 min sd MP). Presents the fundamentals of handling hand saws and choosing the right saw for the job.

CHISELS (Plumb 12min sd MP). Depicts uses and care.

HACKSAWS (Plumb 18min sd MP). Describes proper selection of blades for various metals and correct methods of use.

PLIERS AND SCREWDRIVER (Plumb 17min sd MP). Shows the rules to be followed when using these tools.

PUNCHES, DRIFTS AND BARS (Plumb 14min sd MP). Portrays types and sizes for particular jobs and correct handling.

WRENCHES (Plumb 20min sd MP). Depicts proper use of flat and socket wrenches, including attachments.

3. ROOFING AND SIDING

RAGS TO ROOFS (Iowa 30min si MP). The story of asphalt shingles.

ROOFS (Rubberoid 35min sd C MP). A history of the invention of asphalt, ready-to-lay roofing; process of manufacturing asphalt shingles and roofings; demonstrates asphalt roofing products.

5. FINISH—TRIM, WINDOWS AND DOORS

THE TREE OF LIFE (USDA 20min sd MP). Describes the importance of forests in our national life and the achievements of the Forest Service.

TREES AND MEN (Association 40min sd MP). Describes lumbering and mill operations.

TREES AND HOMES (Weyerhauser 33min sd C MP). Shows logging and mill operations.

PLYWOOD, THE MIRACLE Wood (Douglas 35min sd MP). Portrays the uses of the material in industry with the story of its manufacture.

MIRACLE IN Wood (Douglas 35min sd C MP). Shows the making of plywood; the giant peeler logs; blocks peeled into veneer and veneer into plywood.

AMERICAN WALNUT (American Walnut 22min sd C MP). Describes the manufacture of solid and veneer construction; the making of plywood; how figured paneled surfaces are produced.

ROMANCE OF MAHOGANY (Mahogany 45min si MP). Describes the making of mahogany lumber and veneers from the felling of trees in the tropical jungles to the factory.

HOW TO FINISH PLYWOOD (Douglas 22min sd C MP). Depicts finishing of plywood, painting, staining, and enameling.

DOORWAY TO HAPPINESS (FDI 30min sd C MP). Gives a brief logging scene, a complete description of the manufacture of doors and millwork; shows how doors should be used and cared for in homes.

FABRICATING THE WESTERN PINES (Western Pine 30min sd MP). Presents logging methods, sawmill operation, fabrication and installation of sash, doors, frames, etc.

6. GLASS—GLAZING—INSULATION

MAKING GLASS (United 15min si MP). Describes the process from the furnace to the finished object.

SAFETY GLASS (USBM 30min si MP). Tells the story of safety glass from the preparation of raw materials to the finished product.

THE STORY OF ROCK WOOL HOME INSULATION (Johns-Manville 25min sd MP). Shows the manufacture and use of this type of insulation.

7. LUMBER—GRADING AND MEASURING

FELLING FOREST GIANTS (Vesco 15min si MP). Shows lumbering in the Carolinas and the Northwest; various methods of handling.

LUMBERING IN THE PACIFIC NORTHWEST (EBF 15min si MP). Describes lumbering from the laying of the railroad to the shipping of the lumber.

LUMBERING IN BRITISH COLUMBIA (Illinois 15min si MP). Shows lumbering operations from the felling of the giant trees to the exporting of the finished product.

REDWOOD SAGA (Haselton 14min si MP). Shows the redwood lumber industry of northern California, the cutting, loading, transporting, mill sawing, and finishing operations.

8. SCAFFOLDS AND SAFETY MEASURES

SAFETY IN THE SHOP (USOE 12min sd MP). Dramatizes typical shop accidents; shows how poor supervision or inadequate training may be the real cause behind these accidents; emphasizes the supervisor's responsibility in teaching and maintaining safe practices in the shop.

9. BLUEPRINTS AND SPECIFICATIONS

BEHIND THE SHOP DRAWING (Illinois 20min sd MP). Describes method of making drawings and blueprints.

BUILDING A HOME WITH WESTERN PINES (Western Pine 30min sd MP). Portrays the step-by-step building of a house.

HOME BUILDERS AT WORK (Purinton 45min si MP). Pictures the building of a home from the planning and blueprint stage to its occupation; depicts various trades involved in its construction.

GENERAL

CARPENTRY (SVE FS).

CABINET MAKING (SVE FS).

THE WOODWORKER (VGF 11min sd MP). Describes all phases of the woodworking field; shows how student can prepare himself.

THE BUILDERS (EBF 20min sd MP). Shows the construction of a skyscraper, the work of draftsmen, wreckers, excavators, steel workers, laying of concrete floors, bricklaying and marble work, plumbers, terra cotta and tile setters, plasterers, roofers, painters, and the men who install elevators.

MANUFACTURE OF WIRE PRODUCTS (Illinois 15min si MP). Shows the processes involved in making wire from raw materials to all sorts of finished wire products.

STEEL: WIRE AND WIRE PRODUCTS (Illinois 15min si MP). Describes the step-by-step process of making wire products from steel.

FURNITURE CRAFTSMEN (EBF 11min sd MP). Shows pattern making, sawing, power planing, joining, etc., to finishing stages in close-up detail; interrelation of hand and machine-tool operation.

FURNITURE MAKING (EBF 15min si MP). Contrasts important period

styles of the past with styles of today; master craftsmen at work; modern methods in machine production.

MASTERPIECES IN MAHOGANY (Mahogany 30min si MP). Tells the story of the reproduction of a fine eighteenth-century mahogany table; describes the procedure from the design to the final finishing steps.

BEVELING, MITERING, RABBETING, AND DADOING (USOE 19min sd MP). Shows how to cut a bevel with tilted fence; set a miter gauge; use a stop block in mitering; set the fence and blade for cutting rabbets; and install and use a dado head.

CUTTING TENONS AND SEGMENTS (USOE 15min sd MP). Shows how to lay out and cut a tenon; prepare a jig to trim and miter segments; and guide the jig, using a sliding miter gauge.

PLANING ROUGH SURFACES TO DIMENSIONS (USOE 17min sd MP). Shows how to adjust the table for desired thickness; set feed rolls for proper speed; feed with the grain; and surface short pieces and glued stock.

RIPPING AND CROSCUTTING (USOE 19min sd MP). Shows how each working part of the variety saw functions; check saw blades; set the fence; change saw blades; use a cutoff gauge; and use a hinged block in crosscutting.

SOURCES OF FILMS LISTED ABOVE

American Walnut Mfgrs. Assn., 616 S. Michigan Blvd., Chicago 5.
Association Films, YMCA Motion Picture Bureau, 347 Madison Ave.,
New York 17.

Castle Films, 30 Rockefeller Plaza, New York 20.

Coronet Instructional Films, 919 N. Michigan Ave., Chicago 11.

Douglas Fir Plywood Assn., 301 Tacoma Bldg., Tacoma 2, Wash.

EBF—Encyclopaedia Britannica Films, Inc., 20 N. Wacker Dr., Chicago 6.

FDI—Fir Door Institute, Tacoma Bldg., Tacoma 2, Wash.

GM—General Motors Corp., Dept. of Public Relations, 1775 Broadway,
New York 19.

Haselton, Guy D., 7936 Santa Monica Blvd., Hollywood 46, Calif.

Illinois, University of, Visual Aids Service, Champaign, Ill.

Iowa State College, Visual Instruction Service, Ames, Iowa.

JH—Jam Handy Organization, 2900 E. Grand Blvd., Detroit 11, Mich.

Johns-Manville, 22 E. 40th St., New York 16.

Mahogany Assn., Inc., 75 E. Wacker Dr., Chicago 1.

Plomb Tool Co., 2209 Santa Fe Ave., Los Angeles 54, Calif.

Purinton Films, 4404—42nd St., San Diego 5, Calif.

Rubberoid Co., 500 Fifth Ave., New York 18.

SVE—Society for Visual Education, 100 E. Ohio St., Chicago 11.

USBM—U. S. Bureau of Mines Experiment Station, 4800 Forbes St.,
Pittsburgh 13, Pa.

USDA—U. S. Dept. of Agriculture, Motion Picture Dept., Washington
25, D. C.

USOE—U. S. Office of Education (Obtainable from Castle Films).

United World Films, Inc., 1250 Sixth Ave., New York 20.

Vesco Film Library, Audio-visual Corp., 116 Newbury St., Boston 16,
Mass.

VGF—Vocational Guidance Films, 2708 Beaver Ave., Des Moines 10,
Iowa.

Western Pine Assn., Yeon Bldg., Portland 4, Oreg.

Weyerhauser Sales Co., First National Bank Bldg., St. Paul 1, Minn.

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